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ABSTRACT

This curriculum guide contains materials for a 13-unit course in advanced metals, the second metals course in the industrial arts curriculum for grades 10-12. It is intended for use by industrial arts teachers, supervisors, counselors, administrators, and teacher educators. A two-page course overview provides a brief course description; indicates target grade level, prerequisites, course goals, and course objectives; presents an introduction to the course; and suggests a time frame. The detailed, 21-page course outline follows. A unit teaching guide in a column format relates objectives to topics, student activities, teacher activities, and resources. The 13 units cover these topics: general safety, careers, planning, advanced metal working tools, sheet metal work and layout, metallurgy and heat treating, casting, welding, machinery, materials testing, finishing, automation technology, and safety review. Extensive appendixes include sample materials, forms, and information related to classroom management; crossword and wordfind puzzles with solutions; safety and machine handouts/transparency masters; suggested project listings (project and sources); and lists of these types of resources: films, computer periodicals, and periodicals for metals instructors. A bibliography is provided. (YLB)

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ADVANCED METALS

(Industrial Arts)

CURRICULUM GUIDE

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STATE OF LOUISIANA

DEPARTMENT OF EDUCATION

BULLETIN 1750

ADVANCED METALS
(Industrial Arts)

1985

Office of Vocational Education

Elaine Webb, Ed.D.
Assistant Superintendent

Thomas G. Clausen, Ph.D.
State Superintendent

TABLE OF CONTENTS

Foreword i
Acknowledgements ii
Course Flow Chart 1
Course Description 2
Target Grade Levels 2
Prerequisite 2
Goals and Objectives 2
Introduction 3
Suggested Time Allotment 3
Course Outline 4

Unit Teaching Guide

Unit I General Safety 27
Unit II Careers 28
Unit III Planning 29
Unit IV Advanced Metalworking Tools 31
Unit V Sheet Metalwork and Layout 33
Unit VI Metallurgy and Heat Treating 37
Unit VII Casting 40
Unit VIII Welding 42
Unit IX Machinery 52
Unit X Materials Testing 59
Unit XI Finishing 60
Unit XII Automation Technology 61
Unit XIII Safety Review 62
Appendix 1 Classroom Management 63
Appendix 2 Crossword and Wordfind Puzzles 79
Appendix 3 Safety and Machine Pictures 120
Appendix 4 Suggested Project Listings 152
Appendix 5 Resources 157
Bibliography 166

FOREWORD

This publication is a guide for the improvement of instruction in Industrial Arts Education for the State of Louisiana. It should be of benefit to industrial arts teachers, supervisors, counselors, and administrators. These operational guidelines will help local administrators, teacher educators, and industrial arts teachers to determine the extent to which their programs are meeting the needs of our youth. Industrial Arts Education Programs must be organized to meet the needs of all students.

A constant concern of educators is the construction and revision of curriculum. Industry and technology are the core of industrial arts instruction. Both are constantly changing; therefore, curriculum and instruction must change in order to provide students a realistic and accurate understanding of industry and its function in our complex technological society.

Thomas G. Clausen
THOMAS G. CLAUSEN, Ph.D.
STATE SUPERINTENDENT OF EDUCATION

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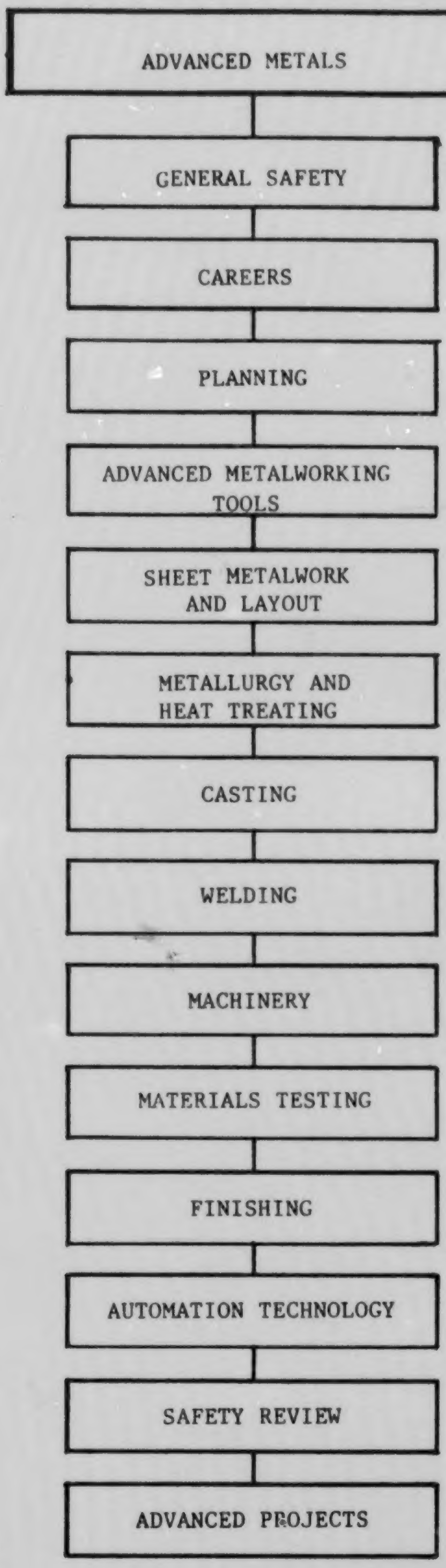
Office of Vocational Education


ADVANCED METALS
GENERAL SAFETY
CAREERS
PLANNING
ADVANCED METALWORKING TOOLS
SHEET METALWORK AND LAYOUT
METALLURGY AND HEAT TREATING
CASTING
WELDING
MACHINERY
MATERIALS TESTING
FINISHING
AUTOMATION TECHNOLOGY
SAFETY REVIEW
ADVANCED PROJECTS

Title:

Advanced Metals

Course Description:

Advanced Metals, the second metals course in the Industrial Arts curriculum, is designed for the student with a continuing interest in Metalworking and involves the exploration of the areas of Sheetmetal, Metallurgy, Casting, Welding, Machining, Materials Testing, Finishing, Safety, and the use of tools, machines, and materials to plan, design, and construct metal products in the above areas.

Target Grade Levels:

Grades 10 - 12

Prerequisite:

Basic Metals

Course Goals:

In Advanced Metals the student will become acquainted with career opportunities available in the fields of Sheet metal, Metallurgy, Casting, Welding, Machining, Testing, and Finishing and will be exposed to the importance each field has on life. Also, laboratory experiences will be provided to give a variety of advanced "hands-on" working knowledge of tools, machines, and equipment to develop an understanding of the Metals Industries.

Course Objectives:

To develop an awareness of the impact of metalworking on society.

To provide experiences in several metalworking areas so as to develop an understanding of the technology in the metal industries.

To develop an awareness of the impact of metalworking on society.

To provide experiences in several metalworking areas so as to develop an understanding of the technology in the metal industries.

To develop safe work habits.

To increase understanding of the occupational requirements and opportunities in the metal fields.

To teach the necessary related information and develop the essential skills needed in the design, fabrication, heat treating, welding, machining, and finishing of industrial products for prevocational and avocational pursuits.

Introduction

This is an age of metal. In almost every activity of our lives we use metal articles which, in turn, were made by metal machines. The metalworking industries in the United States employ more workers than any other industries. Highly specialized metal trades and industries offer many worthwhile careers. By studying and participating in the various Advanced Metal areas as outlined in this course, students will have the opportunity to advance their knowledge and further develop the manipulative skills used in the metalworking industries.

Advanced Metals is designed as the second phase for a student who is entering the highly skilled field of metals. The course is broken down into six major fields: Advanced Metalworking Tools, Sheet Metalwork and Layout, Metallurgy and Heat Treating, Casting, Welding, and Machining.

The student will be re-exposed to the fundamental practices of these fields, but will study more technical knowledge in these fields and receive valuable "hands-on" experience through the construction of individual projects. Also the students will be instructed in the planning and finishing of their project. In addition to these areas, safe use of all and power tools, equipment, and material handling will be taught in the course.

Suggested Time Allotment

The suggested time frame for Advanced Metals is 174 days. The remaining six days are to be used as necessary for the opening and closing of the metals laboratory, school functions, and in units for which the instructor feels additional time is needed.

ADVANCED METALS

I. GENERAL SAFETY

A. General Safety

1. Course syllabus
2. Classroom rules and regulations
3. General safety

II. CAREERS IN METALWORKING

A. Levels of Skills

1. Semi-skilled
2. Skilled
3. Technicians
4. Professions

B. Occupations

1. Steelworker (structural)
2. Welder
3. Tool and die maker
4. Sheet metal technician
5. Machinist
6. Machine operator
7. Boiler maker
8. Molder
9. Pipe fitter
10. Plumber
11. Millwright
12. Pattern maker
13. Metallurgical engineer
14. Aerospace engineer
15. Instrument technician
16. Industrial technologist
17. Computer programmer
18. Industrial engineer
19. Set-up worker
20. Helpers

C. Methods of Training

1. High school
2. Vo-Tech school
3. College
4. Apprenticeship
5. On-the-job training

C. Marking Tools

1. Surface gauge
2. Vernier height gauge
3. Trammel
4. Dividers
5. Scriber (scratch awl)

V. SHEET METALWORK AND LAYOUT

A. Pattern Making

1. Parallel line development
    - a. prisms
    - b. cylinders
    - c. truncated objects
2. Radial line development
    - a. cones
    - b. funnels
    - c. pyramids
3. Triangulation
    - a. offsets
    - b. transitionals
    - c. tapers

B. Hand Tools

1. Hand snips
    - a. straight
    - b. circular
    - c. double-cutting
    - d. hawk-bill
    - e. aviation
        - (1) straight
        - (2) left cut
        - (3) right cut
    - f. compound lever slitting
    - g. bench shears
2. Nibblers
3. Punches
    - a. solid
    - b. hollow
    - c. hand-lever
    - d. chassis
4. Sheet metal gauges
    - a. U.S. Standard (ferrous)
    - b. English Standard Wire (non-ferrous)
5. Hammers
    - a. rivet
    - b. setting
    - c. raising
    - d. ball-peen

        - e. mallets
            - (1) rubber
            - (2) leather
            - (3) plastic
            - (4) wood
            - (5) brass
            - (6) lead
        - f. planishing
        - g. forming
        - h. cross-peen
        - i. straight-peen
    - 6. Hand seamer
    - 7. Hand groover
    - 8. Soldering copper
    - 9. Safety

C. Machines and Equipment

- 1. Machines
    - a. squaring shear
    - b. bar folder
    - c. box and pan brake
    - d. slip roll forming machine
    - e. combination rotary machine
        - (1) burring
        - (2) wiring
        - (3) crimping
        - (4) setting down
        - (5) double seaming
    - f. tab notcher
    - g. bench nibbler
    - h. turret punch
    - i. ring and circle shear
    - j. portable power shears
    - k. cornice brake
    - l. press brake
    - m. power slitting shear
    - n. grooving machine
    - o. Pittsburgh lock forming machine
    - p. bench shear
    - q. throatless bench lever shears
    - r. coper
- 2. Equipment
    - a. universal stake holder
    - b. stakes
    - c. bench plates
- 3. Safety

D. Bending and Shaping Operations

- 1. Hems
    - a. single
    - b. double

- 2. Edges
  - a. wired
  - b. burred
  - c. crimped
- 3. Seams
  - a. lap
  - b. flat-lock groove
  - c. double seam
  - d. corner seam
  - e. Pittsburgh lock
  - f. double bottom
  - g. lap strip
- 4. Safety

E. Sheet Metal Fastening

- 1. Riveting
  - a. solid rivets
    - (1) tinners
    - (2) flathead
    - (3) roundhead
    - (4) countersunk
  - b. pop
  - c. explosive rivet
  - d. rivet set
- 2. Screwing
- 3. Soldering
  - a. flux
  - b. solder
- 4. Spot welding
- 5. MIG welding
- 6. TIG welding
- 7. Safety

VI. METALLURGY AND HEAT TREATING

A. Mechanical Properties

- 1. Hardness
- 2. Toughness
- 3. Brittleness
- 4. Elasticity
- 5. Tensile strength
- 6. Malleability
- 7. Compression strength
- 8. Ductility
- 9. Machinability
- 10. fusibility
- 11. rigidity

B. Physical Properties

- 1. Melting point

2. Specific gravity
3. Thermal expansion
4. Thermal conductivity
5. Electrical conductivity
6. Corrosion resistance
7. Weight
8. Color
9. Density

C. Classifications

1. Ferrous
    a. iron
        (1) iron ore
        (2) pig iron
        (3) cast iron
        (4) wrought iron
        (5) steel
    b. steel
        (1) carbon
            (a) mild
            (b) medium
            (c) high
        (2) alloy
            (a) high speed
            (b) special
        (3) ways to make steel
            (a) Bessemer converter
            (b) open hearth
            (c) electric furnace
            (d) basic oxygen process
            (e) crucible furnace

2. Non-ferrous
    a. aluminum
    b. tin
    c. zinc
    d. copper
    e. lead
    f. silver
    g. others - see appendix
3. Alloys
    a. stainless steel
        (1) molybdenum steel
        (2) titanium steel
        (3) vanadium steel
        (4) tantalum steel
        (5) chromium steel
    b. nickel steel
        (1) monel
        (2) inconel
        (3) hasteolly
    c. magnesium steel

D. Identification

1. Surface appearance
2. Sound
3. Spark test
    a. color
    b. length
    c. shape
    d. number
4. Melting point
5. Grain structure
    a. pearlite
    b. ferrite
6. Color coding
7. Chip test
8. Magnetic test
9. Fracture test
10. Density or specific gravity
11. Chemical
12. Flame
13. Number system
    a. S.A.E.
    b. A.I.S.I.

E. Heat Treating

1. Types
    a. annealing
    b. normalizing
    c. tempering
    d. hardening
    e. case hardening
        (1) cyaniding
        (2) carburizing
        (3) nitriding
        (4) flame hardening
        (5) induction
        (6) laser
        (7) electron beam
    f. spheroidizing
    g. stress relieving

VII. CASTING

A. Sand Casting

1. Patterns
    a. simple (one piece)
    b. split
        (1) positive draft
        (2) negative draft

2. Tools
    a. flask
    b. sprue and riser
    c. ram
    d. bottom board
    e. fiddle
    f. strike off bar
    g. lifter, slick, and oval
3. Molding sand
    a. tempering sand
4. Furnace equipment
    a. crucible furnace
    b. tongs
    c. crucible
5. Safety

B. Shell-Mold Casting

1. Resin-coated sand
2. Heated pattern
3. Smoother finish
4. Thin shelled
5. Half molds

C. Die Casting

1. Air injected
2. Hot chamber (plunger)
3. Cold chamber

D. Permanent-Mold Casting

1. Accurate (± 0.010")
2. Gravity
3. Reusable mold
    a. graphite
    b. metal
4. Release agent
5. Not suitable for thin walls

E. Investment Casting (Lost Wax Process)

1. Shell molding
2. Flask molding
3. Patterns
    a. wax
    b. plastic
    c. frozen mercury

F. Plaster Mold Casting

1. Reusable pattern (few times)
2. Cast metals with low melting
    points (400° - 1700° F.)

G. Centrigugal Casting (Rotated on Longitudinal Axis)

H. Centrifugal Casting (Central Sprue)

I. Slush Casting (Hollow Casting)

1. Slip molding
2. Dipping

J. Silicone Rugger Molding

1. Used for prototypes
2. Good surface finish
3. Cast metals of low melting points

VIII. WELDING

A. Safety

1. Oxyacetylene welding safety
2. Cylinder handling safety
3. Arc welding safety
4. Basic electrical safety
5. Fire prevention safety
6. General precautions

B. General Welding Shop Tools and Equipment

1. Cylinders
    a. oxygen
    b. air
    c. fuels
    d. inert gases
2. Regulators
    a. single-stage
    b. double-stage
    c. flow meters
3. Hoses
    a. colors
    b. size
    c. coupling
4. Proper clothing
    a. gloves
        (1) leather
        (2) cotton
        (3) asbestos

    b. eye protection
        (1) safety glasses
        (2) goggles
        (3) face shields
        (4) hoods
    c. footwear
    d. shirts
    e. pants
    f. bib, jackets, or aprons
5. Welding machines
    a. transformer - A.C.
    b. motor - generator - D.C.
    c. rectifier - A.C. and D.C.
6. Chipping hammers
7. Tip cleaners
8. Strikers (flint lighter)
9. Tongs
10. Brushes
    a. stainless steel
    b. carbon steel
11. Grinders
    a. bench
    b. side
    c. die
12. Oxy-acetylene tips
    a. heating
    b. welding
    c. cutting

C. Oxy-Fuel Welding and Cutting and Brazing

1. Fuel gases
    a. acetylene
    b. mapp (methylacetylene propadiene)
    c. propane
    d. natural gas
    e. hydrogen
    f. others
2. Characteristics of a good weld
    a. consistent width
    b. straightness
    c. slightly crowned
    d. fused to base metal
    e. clean appearance
3. Weld quality factors
    a. proper flame adjustment
    b. angle of tip
    c. distance from work
    d. speed of travel
    e. movement of tip

4. Means of selecting tip size
    a. metal thickness
    b. size of welding rod
5. Means of selecting rod size
    a. properties of base metal
    b. thickness of metal
6. Flame types
    a. neutral
    b. oxydizing
    c. carburizing
7. Causes of backfires
    a. dirty tip
    b. loose tip
    c. bad O-rings in torch
    d. improper pressure
    e. hot tip
    f. tip too close to metal
    g. kink in hose
    h. leak in hose
8. Results of flashbacks
9. Steps to follow in case of flashback
    a. close oxygen torch valve
    b. close acetylene torch valve
    c. release oxygen regulator screw
    d. release acetylene regulator screw
    e. inspect equipment
10. Differences between fusion welding and brazing
    a. the temperature of the process
    b. the principle of the joint
11. Composition of brass
    a. copper
    b. zinc
12. Three proper methods of physically cleaning metal for brazing
    a. file
    b. sand
    c. grind
13. Factors relating to joint strength
    a. clean metal
    b. correct heat
    c. joint structure
    d. proper amount filler rod
14. Characteristics of a good oxy-acetylene cut
    a. no slag
    b. square face
    c. straight path
    d. sharp edges
    e. properly shaped drag lines

15. Pressure control mechanisms for cutting torches
    - a. pre-heat oxygen valve
    - b. torch body oxygen valve
    - c. torch body acetylene valve
    - d. oxygen high pressure cutting lever
16. Cutting tips
    - a. several sizes
    - b. various shapes
    - c. pre-heat orifice
        - (1) several
        - (2) smaller
        - (3) heats metal to kindling point (1600° F.)
    - d. cutting orifice
        - (1) larger
        - (2) high pressure pure oxygen
17. Reasons for poor cuts
    - a. preheat flames too small
    - b. cutting speed too slow
    - c. preheat flames too long
    - d. cutting oxygen pressure too low
    - e. cutting oxygen pressure too high
    - f. cutting speed too fast
    - g. motion of travel unsteady
    - h. cut lost and not carefully restarted

D. Shielded Metal Arc Welding

1. Types of electrodes
    - a. non-consumable (refractory)
        - (1) tungsten - 6100° F. melting point
        - (2) carbon - 6512° F. melting point
    - b. consumables (filler metal)
2. Currents
    - a. alternating (AC)
    - b. Direct (DC)
        - (1) negative polarity electrode (straight)
        - (2) positive polarity electrode (reverse)
3. Factors to consider when setting amperage
    - a. thickness of metal
    - b. size of metal
    - c. type of joint
    - d. size of electrode
    - e. type of electrode
    - f. length of cable
4. Duty cycle
5. Electrode angles
6. Arc lengths

7. Reasons for poor welds
    a. current too low
    b. current too high
    c. arc length too long
    d. arc length too short
    e. speed too slow
    f. speed too fast
    g. improper angle
    h. improper electrode type
    i. improper electrode size
    j. improper base metal preparation
8. Arc welding joints and welds
    a. butt
    b. fillet
    c. edge
    d. flange
    e. lap
    f. bead
    g. tack
    h. corner
    i. weave
    j. pad
    k. multipass
    l. plug
9. Welding positions
    a. flat
    b. vertical
    c. horizontal
    d. overhead
10. Electrode selection
    a. comparison of bare electrodes to covered electrodes
    b. filler rod composition
        (1) mild
        (2) stainless
        (3) cast iron
        (4) non-ferrous
        (5) low hydrogen
    c. coverings
        (1) function
        (2) composition
    d. size
11. Methods of striking arc
    a. tapping
    b. scratching
12. Lens shade selection
13. Electrode identification
    a. number - AWS
    b. Color marking - NEMA
        (1) end
        (2) spot
        (3) group

14. Arc cutting

E. Tungsten Inert Gas Welding - GTAW - TIG

1. Shielding gases
   a. argon
   b. helium
   c. CO_2
2. Current usages
3. Advantages
4. Power supply controls
5. Torches
6. Nozzle types
7. Electrodes
8. Fillers
9. Characteristics of good welds
10. Reasons for poor welds

F. Metal Inert Gas Welding - GMAW - MIG

1. Major parts
2. Advantages
3. Applications
4. Characteristics of good welds
5. Effects of wire stickout
6. Causes of poor welds
7. Types of wires
8. Factors in selection of filler wire
9. Major parts of equipment
10. Shielding gases

G. Resistance Welding

1. Spot welding
2. Seam welding
3. Flash-butt welding
4. Projection welding
5. Percussion welding
6. Upset welding

H. Other Welding Processes

1. Ultrasonic welding
2. Friction welding
3. Forge welding
4. Explosion welding
5. Diffusion welding
6. Cold welding
7. Electron beam welding
8. Electroslag welding
9. Induction welding

10. Laser-beam welding
11. Thermit welding
12. Submerged-arc welding
13. Plasma-arc welding

I. Welding Print Reading

J. Principal Weld Defects

1. Incomplete fusion
2. Lack of fusion
3. Undercutting
4. Slag inclusions
5. Porosity
6. Cracking
7. Dimensional defects
8. Brittleness

IX. MACHINING

A. Power Sawing

1. Power hacksaw
    a. dry cutting
    b. wet cutting
    c. cutting speed
    d. blades
        (1) length
        (2) tooth pitch
    e. safety
2. Horizontal band saws
    a. advantages over power hacksaw
        (1) smaller kerf
        (2) increased cutting speed
        (3) feed and speed control
    b. safety
3. Abrasive cutoff saws
    a. fixed head
    b. oscillating head
    c. size
    d. safety
4. Vertical band saws
    a. types of cutting
        (1) straight-line cuts
        (2) angular cuts
        (3) curved-line cuts
        (4) internal-contour cutting
    b. band filing
    c. band polishing
        (1) abrasive belt
        (1) special guide for saw
    d. safety

B. Drilling Machines

1. Handfed drill press
    a. step pulley
    b. variable speed pulley
2. Back-geared upright drill
3. Gang drill
4. Multiple-spindle drill
    a. multiple drill bits
    b. same time drilling
5. Radial drill press
6. Turret drill press
7. Twist drills
    a. straight-shank drill
        (1) four flute
        (2) three flute
        (3) two flute
        (4) oil hole
        (5) subland drill
    b. taper shank drills
    c. center drill
    d. counter sinks
8. Drilling operations
    a. countersinking
    b. reaming
    c. counterboring
    d. spotfacing
    e. boring
    f. tapping

C. Lathes and Lathe Operations

1. Kinds of lathes
    a. manually operated lathe
    b. screw machines
    c. turret lathes
    d. tracer lathe
    e. numerically controlled lathes
    f. CNC
2. Lathe operations
    a. facing
    b. counter boring
    c. threading
        (1) inside
        (2) outside
    d. tapering
    e. turning between centers
    f. knurling
        (1) straight
        (2) diamond

   g. drilling
   h. reaming
3. Parts of lathes
   a. headstock
   b. tailstock
   c. gear box
   d. apron
   e. ways
   f. lead screw
   g. compound rest
   h. power-feed clutch
   i. see Appendix for pictures and complete nomenclature
4. Mounting tools and fixtures
   a. three-jaw chuck
   b. four-jaw chuck
      (1) universal
      (2) independent
   c. face plates
   d. lathe dogs
      (1) bent-tail lathe dog
      (2) clamp type
   e. collet
      (1) round
      (2) square
      (3) hexagon
   f. centers
      (1) live
      (2) dead
   g. spindle chuck
   h. thread gauge
   i. dial-indicator gauge
   j. steady rest
   k. following rest
5. Cutting tools
   a. materials
      (1) high-speed steel
      (2) cast alloys
      (3) cemented carbide
      (4) ceramics
      (5) diamond
   b. types of cutting tools and tool holders
      (1) left-hand
      (2) right-hand
      (3) round-note
      (4) left-hand facing
      (5) right-hand facing
      (6) cut-off tool
      (7) threading
      (8) boring tool
      (9) inside threading

c. cutting-tool terms
  (1) cutting edge
    (a) side
    (b) end
  (2) face
  (3) flank
  (4) nose
  (5) relief
    (a) side
    (b) end
  (6) rake
    (a) side
    (b) end

D. Milling Machines and Milling Operations

1. Types of machines
   a. column and knee
   b. bed
2. Kinds of machines
   a. vertical mill
   b. horizontal mill
   c. combination horizontal, vertical
3. Types of milling cutters
   a. plain-milling cutters
   b. side-milling cutters
   c. angular-milling cutters
   d. end mills
   e. formed cutters
   f. face-milling cutters
   g. special cutters
4. Cutter holding devices
   a. collets
   b. arbors
5. Machine adjustments and controls
   a. knee elevations
   b. table movements
      (1) cross-feed handwheel
      (2) longitudinal-feed control
   c. spindle speed adjustment
   d. feed adjustment
   e. feed direction
6. Milling operations
   a. cutting keyways
   b. slotting
   c. facing
   d. milling grooves
   e. indexing or dividing
      (1) sides
      (2) holes
   f. straddle milling
   g. cutting gears
   h. up milling
   i. down milling

E. Shapers and Shaping

1. Kinds of shapers
    a. horizontal shapers
    b. vertical shapers
2. Parts of shaper
    a. base
    b. table
    c. ram
    d. tool head assembly
3. Machine adjustments
    a. tool slide position
    b. horizontal table movement
    c. table elevation
    d. length of stroke
    e. position of stroke
    f. cutting speed selection
    g. feed adjustment
4. Special forged tools
    a. round-nose tool
    b. side-cutting tool
    c. gooseneck tool (flat cuts)
5. Shaper cuts
    a. vertical cut
    b. angular cut
    c. horizontal cut
    d. angular dovetail cut

F. Ultra Modern Machining Processes

1. Electrical discharge machining (EDM)
2. Electrochemical machining (ECM)
3. Electron beam machining (EBM)
4. Laser beam machining (LBM)
5. Ultrasonic machining (USM)
6. Chemical machining (CHM)

G. Numerical Control and Automation

1. Lathes
2. Milling machines
3. Drilling machines
4. Combination machines

X. MATERIAL TESTING

A. Nondestructive

1. Magnetic particle
2. Radiographic
    a. x-ray
    b. gamma ray

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3. Penetrant
4. Ultrasonic
5. Eddy current
6. Leak test
7. Hardness
    a. Brinell
    b. Rockwell
    c. Vickers
    d. Shore Scleroscope
8. Thermal and infrared
9. Microwave
10. Strain sensing
    a. brittle coatings
    b. photo-elastic coatings
    c. resistance strain gauges
11. Visual

B. Destructive Testing

1. Free-bend test
2. Root-, face-, and side-bend test
3. Fatigue test
4. Longitudinal- and transverse-shear test
5. Guided-bend test
6. Fillet-weld break test
7. Etching
8. Impact test
    a. Izod
    b. charpy
    c. Nick-break test

XI. FINISHING

A. Kinds of Finishing

1. Grinding
2. Polishing
3. Brushing
4. Sanding
5. Buffing
6. Burning
7. Electroplating

B. Application Techniques

1. Brushing
2. Spraying
    a. pressure feed
    b. suction feed
    c. electrostatic
    d. aerosol
    e. flame

3. Powder fusion coating
4. Dip or flow coating
5. Roller coating
6. Tumbling

C. Protective Metal Finishes

1. Primers
2. Metal enamels
3. Lacquers
4. Galvanizing
5. Tin coating
6. Parkerizing

XII. AUTOMATION TECHNOLOGY

A. Robotics

1. Welding
2. Parts manipulation
3. Finishing
4. Hazardous material handling
5. Quality control

B. Computers

1. Computer numerical control (CNC)
2. Computer aided design (CAD)
3. Computer aided manufacture (CAM)

XIII. SAFETY REVIEW

A. General Shop and Lab Safety

B. Personal Safety

C. Tool and Equipment Safety

D. Housekeeping Practices

E. Sheetmetal Safety

F. Heat Treating Safety

G. Casting Safety

H. Oxy-Fuel Processes Safety

I. Arc Welding Safety

J. TIG and MIG Safety

K. Electrical Safety

L. General Machine Shop Safety

M. Machine Operation Safety

    1. Buffers
    2. Drill presses
    3. Grinders
    4. Milling machines
    5. Shapers
    6. Lathes

N. Fire Safety

UNIT I: GENERAL SAFETY 3 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: demonstrate knowledge of course requirements, class rules and regulations, and general safety as it applies to the classroom and basic laboratory experiences.	A. General Safety 1. Course syllabus 2. Classroom rules and regulations 3. General safety	Students will make themselves knowledgeable of all classroom rules and regulations and general safety. Students will be required to take and pass the rule and safety test at a percentage set by the instructor. Test No. 1 - Unit 1	Construct and pass out course syllabus, and discuss rules and regulations. See Appendices 1 and 3 for classroom rules and basic safety rules. See Appendix 2 for Word Find Puzzle on General Safety.	**See Appendix** **Book 2, pp. 3-7** **Book 4, Unit 2** **Book 7, Unit 3** **Book 70, Unit V p. 25**

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UNIT II: CAREERS IN METALWORKING 3 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: identify the various levels of skill within the metal-working industries.	A. Levels of Skills 1. Semi-skilled 2. Skilled 3. Technicians 4. Professions		Invite job consultant to speak on different jobs related to metalworking.	Book 1 Book 2, p. 4 Book 3, Unit 11 Book 4, Unit 1 Book 7, Unit A-1
list some occupations in metalworking.	B. Occupations 1. Steelworker (structural) 2. Welder 3. Tool and die maker 4. Sheet metal technician 5. Machinist 6. Machine operator 7. Boiler maker 8. Molder 9. Pipe fitter 10. Plumber 11. Millwright 12. Pattern maker 13. Metallurgical engineer 14. Aerospace engieer 15. Instrument technician 16. Industrial technologist 17. Computer programmer 18. Industrial engineer 19. Set-up worker 20. Helpers	Students should list all jobs with metal interaction they can think of. Students should identify the skill level of the occupation given.	Lead a discussion on various metalworking occupations.	Book 1, p. 29 Book 2, pp. 7-10 Book 3, pp. 64-73 Book 4 Book 6, p. 187
		Have students research and write a paper on the occupation of their choice including: Job requirements Educational requirements Working hours and conditions Job pay Training requirements	Grade research papers.	Book 1 Book 2, p. 5 Book 3, pp. 64-73 Book 4 Book 7, p. A-1

UNIT III: DRAWING AND PLANNING 7 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to:	A. Review of Working Drawing 1. Assembly drawing 2 Detail drawing a. dimensions b. views 3. Isometric		Show the differences of the types of drawings.	Book 1, p. 123 Book 2, pp. 61-66 Book 3, p. 22 Book 4, p. 50
apply the principles of design in the project drawing.	B. Basic Principles of Design and Construction 1. Alphabet of lines 2. Proportion 3. Balance 4. Emphasis 5. Texture 6. Color 7. Function	Have students design (draw) a small project, then as a group refine their product.	See Appendix 1 for ruler test.	Book 1, p. 124 Book 2, pp. 8-11 Book 3, p. 22 Book 4, p. 50
read a rule to 1/32".	C. Review of Measurement and Shop Mathematics 1. Reading a rule (review) a. 6" rule to 1/32" b. Metric: 1 meter to 1 millimeter 2. Shop math review a. linear foot problems b. square foot problems c. calculating total cost from unit cost	Students should draw a ruler in their notebook to study and identify readings.	Draw an enlarged ruler on the board. Call on students to identify parts. Give quiz on reading a rule.	Book 1, pp. 123 & 365 Book 2, pp. 75-78 Book 3, p. 50 Book 4, p. 57
make a working drawing of his project from a picture or replica.	D. Individual Project Drawing 1. Selection of project 2. Rough sketch 3. Teacher's evaluation of sketch 4. Final drawing (working)	Have students gather project pictures, e.g. catalogs, magazines, newspaper.	Show pictures of past projects (slide show).	Book 1 Book 2, p. 67 Book 3, p. 13 Book 4, p. 66

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
set up and fill out a bill of material when planning a project.	E. Bill Materials 1. Part number 2. Number of pieces (quantity) 3. Part name 4. Material 5. Size: thickness, width, length 6. Unit cost 7. Total cost	Have students fill out a bill of materials and figure total cost for project. See Appendix for sample form.	Draw a bill of material on the board or make a handout sheet to give to students. See Appendix 1 for bill of material form.	Book 1 Book 2, p. 71 Book 3, pp. 43-47 Book 4
list the steps of procedure in building a project.	F. Plan of Procedure 1. Operations (list) 2. Tools (list) 3. Equipment (list)	Complete bill of material by adding the plan of procedure for designed project.	Develop handout sheet to show your format.	Book 1 Book 2, p. 69 Book 3, pp. 43,425 Book 4

UNIT IV: ADVANCED METALWORKING TOOLS 3 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to:	A. Precision Measurement Tools 1. Micrometers a. depth b. thread c. outside d. inside e. vernier	Have students measure different items in the lab.	Demonstrate the proper technique for holding and reading the outside micrometer.	Book 1, pp. 365, 378 Book 2, pp. 100-104 Book 3, pp. 54, 89, 323 Book 4, p. 306
identify the different calipers.	2. Calipers a. vernier b. hermaphrodite c. outside d. inside e. vernier bevel protractor 3. Rules and scales a. machinist b. engineers 4. Dial-indicator		Show different uses for calipers.	Book 1, pp. 67, 75 Book 2, pp. 83-85 Book 3, p. 58 Book 4, pp. 61, 306
	5. Gauges a. go-nogo b. ring c. plug d. feeler gauges e. drill and wire gauge			Book 2, pp. 543-550
identify the different parts of the combination sets.	6. Combination set a. center head b. protractor head c. square head	Mark different angles and find center of round stock with combination set.	Demonstrate marking uses with combination set.	Book 1, p. 365 Book 2, p. 81 Book 3, p. 52 Book 4, p. 62
recognize the different tools by sight.	B. Clamps, Jigs, and Fixtures 1. V-block 2. Parallel 3. Locking pliers 4. Step block 5. Drill press clamps 6. Drill press vise 7. Strap clamps	Identify the clamps and jigs by name in your shop.	Show transparencies of different clamps and fixtures. Call on student to identify clamps or fixtures in shop. See Appendix 3 for handtool safety.	Book 1, p. 365 Book 2, pp. 88, 362 Book 3, p. 82 Book 4, pp. 62, 386

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	a. u-clamps b. plain clamps c. gooseneck d. finger e. screw heel f. double finger 8. C-clamps 9. Bar clamps 10. Pipe clamps 11. Chucks 12. Machine vises			
select and use the correct marking tool for their job.	C. Marking Tools 1. Surface gauge 2. Vernier height gauge 3. Trammel 4. Dividers 5. Scriber (scratch awl)		Point out the different capabilities and functions of each marking tool.	Book 1, p. 367 Book 2, pp. 87, 92 Book 3, p. 49 Book 4, p. 60
		Test No. 2, Units 3 and 4		

UNIT V: SHEET METALWORK AND LAYOUT 10 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: develop each kind of pattern.	A. Pattern Making 1. Parallel line development a. prisms b. cylinders c. truncated objects 2. Radial line development a. cones b. funnels c. pyramids 3. Triangulation a. offsets b. transitionals c. tapers	Lay out line developments on paper for notebook.	Lecture discussion on procedures for line development Filmstrips if available in your area	Book 1, p. 123 Book 2, pp. 228-232 Book 3, p. 155 Book 4, pp.173-178
identify by sight the different names of the snips and punches.	B. Hand Tools 1. Hand snips a. straight b. circular c. double-cutting d. hawk-bill e. aviation (1) straight (2) left cut (3) right cut f. compound lever slitting	List and describe each tool and its function in notebook. Point out different hand tools on tool rack.	Lecture - demonstrate proper hand tool safety and use for each tool.	Book 1, pp. 133-169 Book 2, p. 238 Book 3, p. 162 Book 4, pp. 180-202
safely use all hand tools while performing operations.	g. bench shears 2. Nibblers 3. Punches a. solid b. hollow c. hand-lever d. chassis	Discuss hand tool safety.	See Appendix 2 for wordfind puzzles on sheetmetal.	Book 1, p. 142 Book 2, p. 236 Book 3, p. 129 Book 4, p. 181

UNIT V: SHEET METALWORK AND TOOLS (Continued)

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
measure different thicknesses of metal with sheet gauges.	4. Sheet metal gauges a. U. S. Standard (ferrous) b. English Standard Wire (nonferrous)	List and describe each tool and its function in notebook.	Cut up different sheet metals for students to measure.	Book 1, p. 116 Book 2, p. 233 Book 3, p. 54 Book 4, p. 72
name and identify each type of hand tool.	5. Hammers a. rivet b. setting c. raising d. ball-peen e. mallets (1) rubber (2) leather (3) plastic (4) wood (5) brass (6) lead f. planishing g. forming h. cross-peen i. straight-peen	Identify hammers on tool rack. Describe individual uses.		Book 1, p. 152 Book 2, p. 235 Book 3, pp. 58, 222 Book 4, p. 74 Book 2, p. 261
	6. Hand seamer 7. Hand groover 8. Soldering copper 9. Safety		Demonstrate the proper use of seamer and groover. Show proper soldering technique.	Book 1, p. 152 Book 2, p. 237 Book 3, p. 158 Book 4, pp. 195, 185
identify and describe the use of machines and equipment. safely perform all required operations on machines.	C. Machines and Equipment 1. Machines a. squaring shear b. bar folder c. box and pan brake d. slip roll forming machine	List and describe each machine and its use in student notebook.	Lecture-explain use and function of machines and equipment.	Book 1, pp. 134-183 Book 2, pp. 241-248 Book 3, pp. 162-187 Book 4, pp. 180-202

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	e. combination rotary machine (1) burring (2) wiring (3) crimping (4) setting down (5) double seaming	Perform operations on practice sheets.	See Appendix 3 for sheet metal safety.	
safely perform all required operations on machines.	f. tab notcher g. bench nibbler h. turret punch i. ring and circle shear j. portable power shears k. cornice brake l. press brake m. power slitting shear n. grooving machine o. Pittsburgh lock forming machine p. bench shear q. throatless bench lever shears r. coper	List and describe each machine and its use in student notebook.	Lecture function of machines and equipment.	Book 1, pp. 134-183 Book 2, p. 239 Book 3, pp. 162, 187 Book 4, pp. 180-202
identify (name) and describe the use of each stake.	2. Equipment a. universal stake holder b. stakes c. bench plates 3. Safety	Draw picture of stakes in notebook.	Demonstrate the use of the more common stakes.	Book 1, p. 151 Book 2, p. 247 Book 3, p. 168 Book 4, p. 184
safely perform all bending operations demonstrating proper sheet metal safety.	D. Bending and Shaping Operations 1. Hems a. single b. double 2. edges a. wired b. burred c. crimped	Practice bending operations during lab exercises.	Lecture-list, define bands and operations. Demonstrate bending operations.	Book 1, pp. 165-169 Book 2, p. 232 Book 3, pp. 168-193 Book 4, pp. 188, 191-196

UNIT V: SHEET METALWORK AND TOOLS (Continued)

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	3. seams a. lap b. flat-lock groove c. double seam d. corner seam e. Pittsburgh lock f. Double bottom g. Lap strip 4. Safety			
set and form solid rivets.	E. Sheet Metal Fastening 1. Riveting a. solid rivets (1) tinners (2) flathead	List rivets and describe the setting operations in notebook.	Lecture--identify and define fastening devices. Demonstrate setting solid rivets.	Book 1, p. 175 Book 2, p. 184-188 Book 3, pp. 169-189 Book 4, p. 200
identify the different types of solid rivets.	(3) roundhead (4) countersunk b. pop c. explosive rivet			
	d. rivet set 2. Screwing 3. Soldering a. flux b. solder			Book 1, pp. 170-174 Book 2, pp. 190-193 Book 3, p. 195 Book 4, pp. 205-212
operate the spot welder on different thicknesses of sheet metal.	4. Spot welding 5. MIG welding 6. TIG welding 7. Safety	Spot weld practice sheets together to eliminate burn through.	Demonstrate proper spot welding techniques.	
		Tets No. 3, Unit V	See Appendix 4 for suggested sheet metal projects.	

UNIT VI: METALLURGY AND HEAT TREATING 10 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: list and define six of the eleven properties of metal.	A. Mechanical Properties 1. Hardness 2. Toughness 3. Brittleness 4. Elasticity 5. Tensile strength 6. Malleability 7. Compression strength 8. Ductility 9. Machinability 10. Fusibility 11. Rigidity	List and define each property in student notebook. Explain properties involved when: 1. stretching a piece of copper 2. hitting different metals with a hammer 3. breaking a piece of cast iron	Lecture, discussion, demonstration of some properties	Book 1, pp.18, 21 Book 2, p. 19 Book 3, pp. 30, 367, 374 Book 4, p. 42
list and define five of the nine physical properties of metal.	B. Physical Properties 1. Melting point 2. Specific gravity 3. Thermal expansion 4. Thermal conductivity 5. Electrical conductivity 6. Corrosion resistance 7. Weight 8. Color 9. Density	Weigh different kinds of metal that are in the classroom. Have students identify metals by color.	See Appendix 1 for list of metals.	
list the three classifications of metals. list different metals in each classification.	C. Classifications 1. Ferrous a. iron (1) iron ore (2) pig iron (3) cast iron (4) wrought iron (5) steel	Lecture, notes	Lecture, discussion	Book 1, pp. 3, 8-27 Book 2, pp. 30-34 Book 3, p. 30 Book 4, pp. 32-36
tell the different kinds of steel.	b. steel (1) carbon (a) mild (b) medium (c) high (2) alloy (a) high speed (b) special	Look up and tell the differences in the kinds of steel.	Show the different kinds of metals that are easily obtainable and that are in your lab. hot rolled steel, cold rolled steel, aluminum, brass, copper	Book 4 Book 4, p. 41

UNIT VI: METALLURGY AND HEAT TREATING (Continued)

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
list the ways to make steel and explain one.	(3) ways to make steel (a) Bessemer converter (b) open hearth (c) electric furnace (d) basic oxygen process (e) crucible furnace	List and explain in notebook the ways to make steel.		Book 1, pp. 4-14 Book 2, pp. 34, 41 Book 3, p. 32 Book 4, p. 36
	2. Non-ferrous a. aluminum b. tin c. zinc d. copper e. lead f. silver g. others--see appendix	List or telling of other nonferrous metals.	Ask for other nonferrous metals. See Appendix 1 for metals definitions.	Book 1, pp. 17-18 Book 2, pl. 46-53 Book 3, pp. 39-43 Book 4, pp. 45-50
list three of the five stainless steels given.	3. Alloys a. stainless steel (1) molybdenum steel (2) titanium steel (3) vanadium steel (4) tantalum steel (5) chromium steel	Lecture, notes	Lecture discussion	Book 1 Book 2, pp. 44-45 Book 3, p. 40 Book 4
	b. nickel steel (1) monel (2) inconel (3) hasteolly c. magnesium steel	See appendix for list of metals.		Book 1, p. 14
identify metals by one or more of the identification processes.	D. Identification 1. Surface appearance 2. Sound	After lecture and notes have students identify different metals by one of the identification processes.	Show the students the spark test.	Book 1 Book 2, pp. 56-59 Book 3 Book 4, pp. 42-44 Book 16, pp. 607-616
list some identification processes.	3. Spark test a. color b. length c. shape d. number 4. Melting point		Show the different shapes of metal in lab. See Appendix 2 for puzzle on heat treating.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	5. Grain structure a. pearlite b. ferrite 6. Color coding 7. Chip test 8. Magnetic test 9. Fracture test 10. Density or specific gravity 11. Chemical 12. Flame			Book 1
tell what S.A.E. and A.I.S.I. mean.	13. Number system a. S.A.E. B. A.I.S.I. #14 shape			Book 2, p. 56 Book 3 Book 4
list and explain five of the types of heat treating.	E. Heat Treating 1. Types a. annealing b. normalizing c. tempering d. hardening e. case hardening (1) cyaniding (2) carburizing (3) nitriding (4) flame hardening (5) induction (6) laser (7) electron beam f. spheroidizing g. stress relieving	In the student notebook, list and define the types of heat treating.	Lecture, discussion Demonstrate safe furnace procedures.	Book 1, p. 23 Book 2, pp. 313-322 Book 3, p. 367 Book 4, p. 301

UNIT VII: CASTING 5 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: list and explain the different types of patterns	A. Sand Casting 1. Patterns a. simple (one piece) b. split (1) positive draft (2) negative draft	Have students design and make a one-piece and two-piece pattern (possible group work).	Lecture, discussion Show the difference between positive and negative draft.	Book 1, p. 199-206 Book 2, pp. 266-275 Book 3, p. 291 Book 4, p. 233
identify tools used in foundry area.	2. Tools a. flask b. sprue and riser c. ram d. bottom board e. fiddle f. strike off bar g. lifter, slick, and oval		Demonstrate the procedures (step by step) of sand casting.	
correctly temper molding sand.	3. Molding sand 4. Furnace equipment a. crucible furnace b. tongs c. crucible 5. Safety	Show how to temper molding sand. Light and turn off furnace using proper safety guidelines.	Pour hot metal on a piece of clothing and shoe and demonstrate need for protective clothing. See Appendix 3 for casting safety.	
list and describe five of the ten types of casting.	B. Shell-Mold Casting 1. Resin-coated sand 2. Heated pattern 3. Smoother finish 4. Thin shelled 5. Half molds	Lecture, notes	Lecture, discussion on each type of casting	Book 1, p. 230 Book 2, pp. 277-278 Book 3, p. 306 Book 4, p. 258
	C. Die Casting 1. Air injected 2. Hot chamber (plunger) 3. Cold chamber		See Appendix 2 for puzzles on casting.	Book 1, p. 228 Book 2, p. 282 Book 3, p. 304 Book 4, p. 258

UNIT VII: CASTING (Continued)

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	D. Permanent-Mold Casting 1. Accurate (± 0.010") 2. Gravity 3. Reusable mold a. graphite b. metal 4. Release agent 5. Not suitable for thin walls			Book 1, p. 227 Book 3, p. 305 Book 4, p. 256
	E. Investment Casting (Lost Wax Process) 1. Shell molding 2. Flask molding 3. Patterns a. wax b. plastic c. frozen mercury	Have students design an investment-type of casting and cast out of lead.	Demonstrate a form of investment casting.	Book 1, p. 231 Book 2, pp. 279-280 Book 3, p. 307 Book 4, p. 259
	F. Plaster Mold Casting 1. Reusable pattern (few times) 2. Cast metals with low melting points (400° - 1700° F.)	Lecture, notes	Lecture, discussion on each type of casting	Book 1, p. 230 Book 2, p. 284 Book 3, p. 308 Book 4, p. 260
	G. Centrifugal Casting (rotated on longitudinal axis)		Show film on casting if available in your area.	Book 1, p. 229
	H. Centrifuge Casting (central sprue)			
	I. Slush Casting (hollow casting) 1. Slip molding 2. Dipping			
	J. Silicone Rugger Molding 1. Used for protypes 2. Good surface finish 3. Cast metals of low melting points		See Appendix 4 for suggested projects on casting.	Book 2, p. 287
		Test No. 4, units 6 and 7		

UNIT VIII: WELDING 20 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to:	A. Safety			
pass a test on the material to the satisfaction of the teacher.	1. Oxyacetylene welding safety 2. Cylinder handling safety 3. Arc welding safety 4. Basic electrical safety 5. Fire prevention safety 6. General precautions	Study units. Take test.	Demonstrate explosive power of oxyacetylene gases with balloons (color code balloons). 1st balloon 6" dia.-oxygen 2nd balloon 5" dia. - acetylene 3rd balloon 3" dia. - 1/2 mixture Ignite them in order.	Book 1, pp. 249-255 Book 2 Book 3, pp. 384, 386 Book 4, pp. 268, 279 Book 36, p. 23 Book 72, all Book 74, pp. 1A-25A
	B. General Welding Shop Tools and Equipment			
explain the makeup and fabrication of the various cylinders.	1. Cylinders a. oxygen b. air c. fuels d. inert gases	Construct a model.	Lecture, discussion See Appendix 3 for all welding safety.	Book 1, pp. 249-284 Book 2, p. 199 Book 3, pp. 383-394 Book 4, p. 269
recognize the types of regulators for various needs.	2. Regulators a. single-stage b. double-stage c. flow meters			
match the hose with the use.	3. Hoses a. colors b. size c. coupling		Show film, if available in your area, on gas and arc welding.	
discuss the need for and kinds of clothing needed for various operations.	4. Proper clothing a. gloves (1) leather (2) cotton (3) asbestos			Book 2, p. 201
	b. eye protection (1) safety glasses (2) goggles (3) face shields (4) hoods	Use in practice.	Lecture, discussion Set good example.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
understand the need for these items.	c. footwear d. shirts e. pants f. bib, jackets, or aprons			
differentiate between the various types of machines and their uses.	5. Welding machines a. transformer - A.C. b. Motor - Generator-D.C. c. Rectifier - A.C. and D.C.	List examples of use on tests.		Book 1, p. 266 Book 2, pp. 206-207 Book 3, pp. 382-389 Book 4, p. 269
know when to use each of the tools.	6. Chipping hammers 7. Tip cleaners 8. Strikers (flint lighter)			
	9. Tongs	Use in practice.		
	10. Brushes a. stainless steel b. carbon steel		See Appendix 2 for welding puzzles and wordfind.	Book 4, p. 279
	11. Grinders a. bench b. side c. die			
recognize and use the various tips, as well as describe the parts and adjustments.	12. Oxyacetylene a. heating b. welding c. cutting			
	C. Oxy-Fuel Welding and Cutting and Brazing	Student notebook	Lecture, discussion	
name several examples of fuel gases and their specific characteristics.	1. Fuel gases a. acetylene b. Mapp (methylacetylene propadiene) c. propane d. natural gas e. hydrogen f. others		See safety experiment.	Book 1, pp. 256-296 Book 2, pp. 195-206 Book 3, pp. 383-393 Book 4, p. 269 Book 16, pp. 81-174 Book 19, pp. 3-5 Book 74, pp. 1D-90D Book 36, pp. 135-214

UNIT VIII: WELDING (Continued)

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
list several characteristics of a good weld.	2. Characteristics of a good weld a. consistent width b. straightness c. slightly crowned d. fused to base metal e. clean appearance		Show examples.	
demonstrate knowledge of factors and acquired manipulative skills.	3. Weld quality factors a. proper flame adjustment b. angle of tip c. distance from work d. speed of travel e. movement of tip	Use in practice.	Demonstrate using proper safety to show by example.	
	4. Means of selecting tip size a. metal thickness b. size of welding rod			
	5. Means of selecting rod size a. properties of base metal b. thickness of metal	Student notebook	Lecture, discussion, demonstration	
demonstrate an understanding of when each flame type is used as well as identify by sight.	6. Flame types a. neutral b. oxydizing c. carburizing	Set torch for each type and use each when necessary.	Demonstrate or show pictorial examples.	Book 1, p. 278 Book 2, p. 202 Book 3, p. 388 Book 4, p. 273 Book 16, p. 122 Book 32, pp. 192 A-B
list several examples of the causes and corrective procedures.	7. Causes of backfires a. dirty tip b. loose tip c. bad O-rings in torch d. improper pressure e. hot tip f. tip too close to metal g. kink in hose h. leak in hose		See Appendix 3 for welding chart.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
explain flashbacks and corrective procedures.	8. Results of flashbacks 9. Steps to follow in case of flashback a. close oxygen torch valve b. close acetylene torch valve c. release oxygen regulator screw d. release acetylene regulator screw e. inspect equipment		Stress importance and methods of prevention.	
describe the difference between each process.	10. Differences between fusion welding and brazing a. the temperature of the process b. the principle of the joint	Student notebook Practice each process.	Lecture, discussion	
	11. Compositon of brass a. copper b. zinc 12. Three methods to properly physically clean metal for brazing a. file b. sand d. grind			
discuss the relationship of each of these items to joint strength.	13. Factors relating to joint strength a. clean metal b. correct heat c. joint structure d. proper amount filler rod			
name several characteristics of a good oxy-acetylene cut.	14. Characteristics of a good a. no slag b. square face	Practice straight line cuts and hole piercing.	Show examples.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	c. straight path d. sharp edges e. properly shaped drag lines			
identify and explain use of each pressure control mechanism.	15. Pressure control mechanisms for cutting torches a. pre-heat oxygen valve b. torch body oxygen valve c. torch body acetylene valve d. oxygen high pressure cutting lever			
	16. Cutting tips a. several sizes b. various shapes c. pre-heat orifice (1) several (2) smaller (3) heats metal to kindling point (1600°F.) d. cutting orifice (1) larger (2) high pressure pure oxygen	Student notebook	Lecture, discussion, demonstration Show illustrations of various shapes of tips.	
list several of these reasons and select examples of each group.	17. Reasons for poor cuts a. preheat flames too small b. cutting speed too slow c. preheat flames too long d. cutting oxygen pressure too low e. cutting oxygen pressure too high f. cutting speed too fast g. motion of travel unsteady h. cut lost and not carefully restarted	Critique cuts to find causes of problem.	Show examples.	

UNIT VIII: WELDING (Continued)

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	D. Shielded Metal Arc Welding 1. Types of electrodes a. nonconsumable (refractory) (1) tungsten-6100°F. (2) carbon-6512°F. M.P. b. consumables (filler metal)		Show examples of electrodes and describe when used.	Book 1, pp. 315-336 Book 2, pp. 206-214 Book 3, pp. 394-400 Book 4, pp. 279-388 Book 16, pp. 217-253 Book 36, pp. 319-318 Book 74, pp. 1E-123E
decide when to use the different currents to best advantage.	2. Currents a. alternating (AC) b. Direct (DC) (1) negative polarity electrode (straight) (2) positive polarity electrode (reverse)	Student notebook	Lecture, discussion Explain when each current would be used and the disadvantages of each and how they function.	
	3. Factors to consider when setting amperage a. thickness of metal b. size of metal c. type of joint d. size of electrode e. type of electrode f. length of cable	Experiment with different variables to see effects.		
describe effects of various duty cycles on welding machines.	4. Duty cycle 5. Electrode angles			
explain the effects of angles and arc lengths on welds.	6. Arc lengths		Discuss effects of angles and arc lengths.	
identify the causes of weld defects by comparison with charts.	7. Reasons for poor welds a. current too low b. current too high c. arc length too long d. arc length too short	Identify reasons for poor welds on some sample plates.	Show examples.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	e. speed too slow f. speed too fast g. improper angle h. improper electrode type i. improper electrode size j. improper base metal preparation			
identify different samples of weld joints and welds.	8. Arc welding joints and welds a. butt b. fillet c. edge d. flange e. lap f. bead g. tack h. corner i. weave j. pad k. multipass l. plug	Practice making the various joints and welds.	Lecture discussion Show examples of different welding joints.	
	9. Welding positons a. flat b. vertical c. horizontal d. overhead	Practice welds in different positions.		
select the proper electrode for the job.	10. Electrode selection a. Comparison of bare electrodes to covered electrodes		Show examples of the different types and sizes of rods.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	b. filler rod composition (1) mild (2) stainless (3) cast iron (4) non-ferrous (5) low hydrogen c. coverings (1) function (2) compositon d. size			
	11. Methods of striking arc a. tapping b. scratching		Demonstrate methods	
	12. Lens shade selection	Student notebook	Discuss importance of proper lens shade selection.	
identify basic common electrodes and their characteristics.	13. Electrode identification a. number - AWS b. color marking - NEMA	Create a color chart.		
	14. Arc cutting		Demonstrate.	
select the proper shielding gas for the job.	E. Tungsten Inert Gas Welding - GTAW - TIG 1. Shielding gases a. argon b. helium c. CO_2 2. Current uses 3. Advantages 4. Power supply controls 5. Torches 6. Nozzle types	Practice welding.	Make transparencies.	Book 1, p. 339 Book 2, p. 215 Book 3, p. 401 Book 4, p. 292 Book 16, p. 289 Book 36, pp 378-423 Book 74, pp. 17-1227
	7. Electrodes		Show examples.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
distinguish between good and bad welds.	8. Fillers 9. Characteristics of good welds 10. Reasons for poor welds F. Metal Inert Gas Welding - GMAW-MIG 1. Major parts 2. Advantages 3. Applications 4. Characteristics of good welds	Practice welding.	Show examples of good and bad welds. Make transparencies.	Book 1, p. 346 Book 2, p. 216 Book 3, p. 401 Book 4, p. 292 Book 16, p. 351 Book 36, pp. 337-387 Book 74, pp. 123F-347F
distinguish between good and bad welds.	5. Effects of wire stickout 6. Causes of poor welds 7. Types of wires 8. Factors in selection of filler wire 9. Major parts of equipment 10. Shielding gases	Student notebook	Discuss effects of stickout. Show examples of welds. Lecture, discussion	Book 1, p. 353
define the various types of resistance welding.	G. Resistance Welding 1. Spot welding 2. Seam welding 3. Flash-butt welding 4. Projection welding 5. Percussion welding 6. Upset welding	Research different areas for local use.	Discuss various types and their applications.	Book 3, p. 404 Book 16, p. 410 Book 4, pp. 289-290
explain the different processes of welding.	H. Other Welding Processes 1. Ultrasonic welding 2. Friction welding 3. Forge welding 4. Explosion welding 5. Diffusion welding 6. Cold welding 7. Electron beam welding 8. Electroslag welding	Research applications for industry.	Give explaination of welding processes and examples of uses.	Book 1, pp. 339-360 Book 2, p. 217 Book 3, pp. 400-408 Book 4, pp. 289-294 Book 16, pp. 456-563 Book 36, pp. 483-495

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	9. Induction welding 10. Laser-beam welding 11. Thermit welding 12. Submerged-arc welding 13. Plasma-arc welding			
read welding prints with the aid of a symbols chart.	I. Welding Print Reading		Discuss print symbols	Book 74, pp. 1C-39C
list major weld defects.	J. Principal Weld Defects 1. Incomplete fusion 2. Lack of fusion 3. Undercutting 4. Slag inclusions 5. porosity 6. cracking 7. dimensional defects 8. brittleness		Show examples of each. See Appendix 4 for suggested projects.	
		Test No. 5, Unit 8		

UNIT IX: MACHINING 20 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: identify the different kinds or power sawing. explain the function and advantages of each kind of sawing.	A. Power Sawing 1. Power hacksaw a. dry cutting b. wet cutting c. cutting speed d. blades (1) length (2) tooth pitch e. safety	Lecture, writing notes in notebook Have a student remove and replace blade on each machine.	Lecture, discussion, demonstration See Appendix for safety chart. Demonstrate the proper way to position different shapes of metal for cutting on each machine.	Book 1, pp. 35-40 Book 2, pp. 372-378 Book 3, pp. 84-86 Book 4, p. 410
set up and cut different shapes of metal.	2. Horizontal band saws a. advantages over power hacksaw (1) smaller kerf (2) increased cutting speed (3) feed and speed control b. safety		Demonstrate the proper way to remove and replace broken blades on each machine.	Book 1, p. 37 Book 2, p. 375 Book 3, p. 85 Book 4, p. 413
	3. Abrasive cutoff saws a. fixed head b. oscillating head c. size d. safety		Show proper maintenance procedures for each saw.	Book 1 Book 2, p. 376 Book 3 Book 4
change blade on all kinds of power saws.	4. Vertical band saws a. types of cutting (1) straight-line cuts (2) angular cuts (3) curved-line cuts (4) internal contour cutting b. band filing		Lecture, discussion Demonstrate proper way to cut round stock.	Book 1, p. 37 Book 2, pp. 379-385 Book 3, p. 84 Book 4, p. 413

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	c. band polishing (1) abrasive belt (2) special guide for saw d. Safety			
identify drilling machines in lab.	B. Drilling Machines 1. Handfed drill press a. step pulley b. variable speed pulley			Book 1, pp. 399-422 Book 2, pp. 386-410 Book 3, pp. 86-98 Book 4, pp. 381-395
clamp up and drill holes in any shape stock.	2. Back-geared upright drill 3. Gang drill 4. Multiple-spindle drill a. multiple drill bits b. same time drilling 5. Radial drill press 6. Turret drill press	Show clamping procedure for odd-shaped stock.	Demonstrate the proper way to drill all shapes of stock. See Appendix 3 for drilling safety.	
identify the different types of twist drills.	7. Twist drills a. straight-shank drill (1) four flute (2) three flute (3) two flute (4) oil hole (5) subland drill b. taper shank drills c. center drill d. counter sinks	List and describe the types of twist drills in student notebook.	Lecture, discussion, demonstration Show the various styles of twist drills.	
name all drilling operations and explain what they are.	8. Drilling operations a. countersinking b. reaming c. counterboring d. spotfacing e. boring f. tapping	Show procedure for different drilling operations.	Demonstrate the different drilling operations and explain speeds and lubrication.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
name some kinds of lathes.	C. Lathes and Lathe Operations 1. Kinds of lathes a. manually operated lathe b. screw machines c. turret lathes d. tracer lathe e. numerically controlled lathes f. CNC		Show film series on lathes if available in your area.	Book 1, pp. 426-441 Book 2, pp. 413-414 Book 3 Book 4, pp. 344, 347, 365 Book 46, p. 200
list the basic lathe operations.	2. Lathe operations a. facing b. counter boring c. threading (1) inside (2) outside d. tapering e. turning between centers f. knurling (1) straight (2) diamond g. drilling h. reaming	List and describe lathe operations in student notebook. Practice different lathe operations on scrap material.	Demonstrate and explain all lathe operations showing proper safety procedures. See Appendix 3 for lathe safety.	Book 1, pp. 457-473 Book 2, pp. 439-451 Book 3, pp. 331-344 Book 4, pp. 356-365 Book 46, pp. 159-200 Book 44, pp. 239-260
identify the different parts of the lathe.	3. Parts of lathes a. headstock b. tailstock c. gear box d. apron e. ways f. lead screw g. compound rest h. power-feed clutch i. see Appendix for pictures and complete nomenclature	List the parts of the lathe on handout sheet. Define the purpose of each part. Identify lathe parts when looking at the lathe.	Lecture, discussion, handout, demonstration Point out the different parts on lathe in lab. See Appendix 3 for lathe pictures.	Book 1, pp. 431-441 Book 2, pp. 415-419 Book 3, p. 325 Book 4, p. 347 Book 44, pp. 186-195 Book 46, pp. 135-143

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
set up and use all mounting tools and fixtures available in lab.	4. Mounting tools and fixtures a. three-jaw chuck b. four-jaw chuck (1) universal (2) independent c. face plates d. lathe dogs (1) bent-tail lathe dog (2) clamp type e. collet (1) round (2) square (3) hexagon f. centers (1) live (2) dead g. spindle chuck h. thread gauge i. dial-indicator gauge j. steady rest k. following rest	Show proper use for setting up mounting fixtures.	Demonstrate and explain the purpose of each mounting fixture See Appendix 2 for puzzles on machining.	Book 1, pp. 449-456 Book 2, pp. 421-429 Book 3, pp. 444-449 Book 4, pp. 350-353 Book 44, pp. 202-218 Book 46, pp. 145-168
	5. Cutting tools a. materials (1) high-speed steel (2) cast alloys (3) cemented carbide (4) ceramics (5) diamond	List, define, or describe in student notebook.	Lecture, discussion	Book 1, pp. 441-449 Book 2, pp. 430-434 Book 3, p. 328 Book 4, pp. 350-353 Book 44, pp. 213-219 Book 46, pp. 145-152
	b. types of cutting tools and tool holders (1) left-hand (2) right-hand (3) round-nose (4) left-hand facing	Set up for different direction cuts.	Show the different tools and holders available for your use.	

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	(5) right-hand facing (6) cut-off tool (7) threading (8) boring tool (9) inside threading			
	c. cutting-tool terms (1) cutting edge (a) side (b) end (2) face (3) flank (4) nose (5) relief (a) side (b) end (6) rake (a) side (b) end	Identify parts of cutting tool model.	Make a model of each cutting took out of 1½" x 1½" pine. (Color code parts.)	
identify the different kinds of milling machines.	D. Milling Machines and Milling Operations 1. Types of machines a. column and knee b. bed 2. Kinds of machines a. vertical mill b. horizontal mill c. combination horizontal, vertical	List and describe the types and kinds of milling machines in student notebook.	Lecture, discussion, demonstration Show film on milling machines if available in your area.	Book 1, pp. 487-489 Book 2, pp. 453-458 Book 3, p. 351 Book 4, p. 372 Book 44, p. 308 Book 46, p. 229
select the proper cutter for job.	3. Types of milling cutters a. plain-milling cutters b. side-milling cutters c. angular-milling cutters d. end mills e. formed cutters f. face-milling cutters g. special cutters	Mix cutters available up in a box; pick one out and identify.	Discuss the different types of cutters and their uses. See Appendix 3 for milling safety.	Book 1, pp. 485, 494, 499 Book 2, pp. 468-473 Book 3, pp. 352-353 Book 4, pp. 361-363 Book 44, p. 319 Book 46, p. 235

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
	4. Cutter holding devices a. collets b. arbors	Set up the cutters on the different holding devices.		
adjust the milling machine for any type of cut ±.010.	5. Machine adjustments and controls a. knee elevations b. table movements (1) cross-feed handwheel (2) longitudinal-feed control c. spindle speed adjustment d. feed adjustment e. feed direction		Show how all the adjustments and controls are used on the machine.	Book 2, p. 467 Book 4, p. 376 Book 44, p 313 Book 46, p. 252 Book 1, p. 499 Book 2, pp. 458-459
	6. Milling operations a. cutting keyways b. slotting c. facing d. milling grooves e. indexing or dividing (1) sides (2) holes f. straddle milling g. cutting gears h. up milling i. down milling	List, describe milling operations in student notebook.	Lecture, discussion, demonstration Demonstrate all operations for which you have facilities.	Book 46, p. 232 Book 1, pp. 500-503 Book 2, pp. 478-489 Book 3, p. 453 Book 4, p. 378 Book 44, pp. 337-378 Book 46, p. 258
describe the function of a shaper if one is not available.	E. Shapers and Shaping 1. Kinds of shapers a. horizontal shapers b. vertical shapers 2. Parts of shaper a. base b. table c. ram d. tool head assembly	In student notebook, list and describe the parts, adjustments, and cuts for the shaper.	Discuss the use of the shaper.	Book 1, pp. 482-484 Book 2, pp. 490-495 Book 3, pp. 344-350 Book 4, p. 366 Book 44, p. 273

UNIT IX: MACHINING (Continued)

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
show how to make all machine adjustments.	3. Machine adjustments a. tool slide position b. horizontal table movement c. table elevation d. length of stroke e. position of stroke f. cutting speed selection g. feed adjustment		If available, demonstrate the different kinds of adjustments. See Appendix 4 for suggested machining projects.	
	4. Special forged tools a. round-nose tool b. side-cutting tool c. gooseneck tool (flat cuts)	Student notebook	Lecture, discussion	
set up shaper for each kind of cut.	5. Shaper cuts a. vertical cut b. angular cut c. horizontal cut d. angular dovetail cut			
name three of the six modern machining processes	F. Ultra Modern Machining Processes 1. Electrical discharge machining (EDM) 2. Electrochemical machining (ECM) 3. Electron beam machining (EBM) 4. Laser beam machining (LBM) 5. Ultrasonic Machining (USM) 6. Chemical Machining (CHM)	Research to find more about modern machining processes.		Book 1, p. 534 Book 2, pp. 514-525 Book 3, pp. 361-366 Book 4, p. 416 Book 44, p. 466 Book 46, pp. 421-450
	G. Numerical Control and Automation 1. Lathes 2. Milling machine 3. Drilling machine 4. Combination machines	Test No. 6, unit 9		Book 1, p. 525 Book 2, pp. 526-540 Book 3, pp. 409-410 Book 4, p. 435 Book 44, p. 486 Book 46, p. 341

UNIT X: MATERIAL TESTING 3 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to:	A. Nondestructive	Student notebook	Lecture, discussion	Book 1
	1. Magnetic particle	Do magnetic particle testing.		Book 2, pp. 557-563
	2. Radiographic		Show radiograph examples.	Book 3
	a. x-ray			
list several processes in non-destructive testing.	b. gamma ray			Book 4, pp. 323-333
	3. Penetrant	Do penetrant testing (diesel oil).		
	4. Ultrasonic		Explain principles of ultrasonics.	Book 46, p. 327 Book 52, whole book
explain how several of these processes work and their typical applications.	5. eddy current			Book 36, pp. 71-95
	6. leak test	Do leak test (balloon).		
	7. hardness		Explain hardness testing.	
	a. Brinell			
	b. Rockwell			
	c. Vickers			
	d. Shore scleroscope			
	8. Thermal and infrared			
	9. Microwave			
	10. Strain sensing			
	a. brittle coatings			
	b. photo-elastic coatings			
	c. resistance strain gauges			
	11. visual	Do visual tests.		
list several processes in destructive testing.	B. Destructive Testing			
	1. Free-bend test	Do free-bend test (in vise).		
	2. Root-, face, and side-bend test			
	3. Fatigue test	Do fatigue tests (bending wire).		
	4. Longitudinal-and transverse-shear test			
	5. Guided-bend test		Construct guided-bend tester.	
explain how several of these processes work and their typical applications.	6. Fillet-weld break test			
	7. Etching			
	8. Impact test			
	a. izod			
	b. charpy			
	c. nick-break test			

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UNIT XI: FINISHING 3 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: list and explain the different kinds of finishing.	A. Kinds of Finishing 1. Grinding 2. Polishing 3. Brushing 4. Sanding 5. Buffing 6. Burning 7. Electroplating	List and define in student notebook the kinds of finishing and techniques of application.	Lecture, discussion	Book 1, p. 513 Book 2, pp. 347-351 Book 3, pp. 234-271 Book 4, p. 441 Book 46, p. 395 Book 53, whole book
list and describe different application techniques.	B. Application Techniques 1. Brushing 2. Spraying a. pressure feet b. suction feed c. electrostatic d. aerosol e. flame 3. Powder fusion coating 4. Dip or flow coating 5. Roller coating 6. Tumbling	Experiment: take some scrap steel and prepare it with different methods (see A). Then finish a small section of each with different application techniques using as many finishes (see C) as possible.	Discuss the different advantages of the application techniques. See Appendix 2 for puzzles on finishing.	
finish a project using techniques described in lecture.	C. Protective Metal Finishes 1. Primers 2. Metal enamels 3. Lacquers 4. Galvanizing 5. Tin coating 6. Parkerizing			

UNIT XII: AUTOMATION TECHNOLOGY 8 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to: demonstrate a working knowledge of the use of robots in industry.	A. Robotics 1. Welding 2. Parts manipulation 3. Finishing 4. Hazardous material handling 5. Quality control	Research	Obtain film/filmstrip. Make handouts from appendix. Make transparencies from appendix.	Book 14, p. 499 Book 38, articles Appendix
demonstrate knowledge of the role of the computer in automation.	B. Computers 1. Computer numerical control (CNC) 2. Computer aided design (CAD) 3. Computer aided manufacture (CAM)	Test no. 7, Units 10, 11, 12	Obtain working robot model from Radio Shack. Demonstrate computer capabilities. Obtain permission of local industry for field trip. Obtain guest speaker. See Appendix 5 for material on robotics.	Book 2, p. 520 Book 44, p. 492

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UNIT XIII: SAFETY REVIEW 5 Hours

OBJECTIVES	TOPICS	STUDENT ACTIVITIES	TEACHER ACTIVITIES	RESOURCES
The student should be able to:	A. General Shop and Lab Safety	Read, review safety handout.	Make safety handout to include all safety area.	
	B. Personal Safety			
pass all safety tests given by teacher.	C. Tool and Equipment Safety			
	D. Housekeeping Practices			
	E. Sheetmetal Safety			
	F. Heat Treating Safety			
	G. Casting Safety			
	H. Oxy-fuel Processes Safety			
	I. Arc Welding Safety			
	J. TIG and MIG Safety			Book 70, Safety Manual
	K. Electrical Safety			
	L. General Machine Shop Safety		See all of Appendix 3 for safety rules.	
	M. Machine Operation Safety 1. Buffers 2. Drill presses 3. Grinders 4. Milling machines 5. Shapers 6. Lathes		See Appendix 2 for puzzles on safety.	
	N. Fire Safety	Test - safety		

APPENDIX 1

CLASS MANAGEMENT

SAMPLE
GENERAL INFORMATION
SHEET

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Mr. Angle Iron METALS TECHNOLOGY

I. Expectations:
   A. Have a notebook and pencil in class each day.
   B. Have this general information sheet with you each day.
   C. Be in your seat ready to begin class when the tardy bell rings.
   D. Be respectful and listen when others are speaking.
   E. Bring an excuse for those days absent.

II. Materials for Metals courses:
   A. Notebook (100 page spiral)
   B. Pen or pencil every day
   C. Finishing materials for projects (as required by project)
   D. Lab fee (if required for your course)

III. Grades are determined by the following:
   A. Class participation
   B. Tests and quizzes
   C. Written work, notebook, and projects
   D. Attitude toward work and classroom rules
   E. Work done above and beyond the basic requirements
   F. Grading scale (Type in your own grading scale.)

IV. Classroom Rules

The following of these rules is important to you as a student. Abiding by the general classroom rules will make your classroom experience more enjoyable, safer, and more rewarding.

1. Comply with the requests of the teacher.
2. Bring your notebook and pencil to class every day.
3. Do not make smart remarks to the teacher.
4. Talking is not allowed:
   when the teacher is talking.
   when tests are being given.
   when another student is talking.
   during an audiovisual presentation (film, filmstrips).
5. You may not leave the room without permission and a hall pass.
6. Be in your seat when the tardy bell finishes ringing or you will be marked tardy.
7. Do not leave the room after class until you are dismissed.
8. You must have an excuse for being late to class.
9. Do not use obscene language.
10. All school rules apply in the classroom-lab as well.
11. The shop office is off limits.
12. All paper, trash, etc. must be picked up before class is dismissed.
13. Do not stand in the doorway before class.
14. Do not play in shop, this is the most dangerous place in school.
15. If for any reason you are failing or falling behind, you must be responsible to attack this problem in a systematic way.
    A. Confer with your teacher and get his recommendations.
    B. Report the matter to your parents promptly.
16. Accept helpful criticism gracefully. Remember that your behavior reflects you.

MAKEUP TESTS: (Type your rules for giving makeups.)

PARENTAL PERMISSION SLIP

Metalsville High School
Metals Lab
Mr. Angle Iron

Parents:

______________________________is enrolled in our industrial arts program and will have the opportunity to use various tools and equipment such as:

1. Lincoln arc welder
2. TIG Welder
3. MIG Welder
4. Pedestal grinder
5. Drill Press
6. Jig saw
7. Portable power grinder
8. Portable drill
9. Portable sheet metal cutter
10. Gas Furnace
11. Gas Welders
12. Bar folder
13. Shears
14. Presses
15. Brakes
16. Roll formers

Appropriate instruction in the proper use of the tools and equipment is given and close supervision is maintained. Every precaution is taken to prevent accidents. We are asking your cooperation in impressing your child with the importance of being careful. It is mandatory that all students accept the obligation to obey the safety rules designed to protect them and others.

You are welcome to visit our industrial arts facilities. Please check through the main office.

______________________________has our/my permission to operate the equipment
(student's name)
equipment in the metals laboratory at Metalsville High School. It is understood that instruction in its safe operation will be given before he/she is allowed to use any piece of equipment and that he/she will be properly supervised at all times.

In the case of an accident, it is preferred that he/she be given treatment by:

Dr:____
or Dr:______________________________________
Our home phone number is:____________________
Our work phone number is:____________________

If neither parent/guardian can be reached at the above numbers, please notify:

____________________________ at ____________________________
(responsible person) (telephone number)

Date:________________ Signed:______________________________
(father/guardian)

Address:________________________

Student's birthday:______________ ______________________________
(mother/guardian)

Please advise me of any physical handicaps of medical problems which need to be brought to my attention so that measures may be taken to ensure safe working conditions for your child.

Thank you,
Angle Iron

SHOP FEE LETTER TO PARENTS

(example)

To: All Parents of Metals Students

From: Mr. Angle Iron, Metals Instructor
Metalsville High School

Subject: Shop Fees for Metals Class

As stated in the Metalsville High Handbook, students enrolled in industrial arts are required to pay shop fees.

In the industrial arts courses, Metals I and II, students are required to pay for materials they use on projects that they are allowed to take home.

No set fee is required from students in this Metals course, because the students are required to construct two projects of their choice with the approval of the teacher. The projects must meet the requirements of the course. However, the students are required to pay for the materials used or wasted in the construction of the project. The cost of the projects will vary from project to project and from student to student.

The student will know the approximate cost of the project before he or she begins the construction.

Thank you for your cooperation.

Sincerely,

Angle Iron
Angle Iron
Metals Instructor

C. W. Burrabbit
Principal

Parent's signature:____Date:__________________

PLEASE RETURN THIS SHEET

LIST OF METALS

actinium
aluminum
americium
antimony
arsenic
barium
berkelium
beryllium
bismuth
cadmium
calcium
californium
cerium
cesium
chromium
cobalt
copper
curium
dysprosium
einsteinium
erbium
europium
fermium
francium
gadolinium
gallium
germanium
gold
hafnium
holmium
indium
iridium
iron
lanthanum
lead
lithium
lutecium
magnesium
manganese
mendelevium
mercury
molybdenum
neodymium
neptunium
nickel
niobium
nobelium
osmium
palladium
platinum
plutonium
polonium
potassium
praseodymium
promethium
protactinium
radium
rhenium
rhodium
rubidium
ruthenium
samarium
scandium
silver
sodium
strontium
tantalum
technetium
terbium
thallium
thorium
thulium
tin
titanium
tungsten
uranium
vanadium
ytterbium
yttrium
zinc
zirconium

BILL OF MATERIAL

Name of Project ____________________

Student's Name ____________________ Date Started ____________________

Grade Level ____________________ Date Completed ____________________

Course ____________________ Project Grade ____________________

Instructor's Approval ____________________ Bill of Material Grade ____________________

MATERIALS LIST

PART NO.	NO. OF PIECES	SIZE			NAME OF PART	TYPE OF MATERIAL	UNIT COST	TOTAL COST
		T"	W"	L"				
							TOTAL	

PLAN OF PROCEDURE

STUDENT'S NAME ____________________

NAME OF PROJECT ____________________

TOOLS AND MACHINES REQUIRED

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________

OPERATIONS PERFORMED

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________

PLAN OF PROCEDURE

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________

SHOP JOBS

1. Shop Foreman
2. Sweeper
3. Tool cabinets 1 & 2
4. Large tables
5. Tool cabinets 3 & 4 and goggle cabinet
6. Arc welding tables & welders
7. Tool cabinets 4 & 5
8. Sweeper
9. Soldering table
10. Gas welding tables & torches
11. Tool cabinets 6 & 7
12. Machines
13. Tables
14. Pick up with dust pan
15. Paint cabinet
16. Sweeper
17. Housekeeper
18. Issue and receive projects & housekeeper
19. Window closer
20. Hand tool cleaner
21. Machines
22. Foreman of all tool cabinets control panels (locks cabinet at 7th period)
23. Sweeper
24. Cleans lathe

Everyone has a secondary job:
That of the person above you when that person is absent.

SAFETY INSTRUCTION RECORD

NAME: ____________________
CLASS OR PERIOD: ____________
INSTRUCTOR: ______________

I UNDERSTAND THE SAFETY DEMONSTRATIONS GIVEN FOR THE OPERATIONS AND EQUIPMENT LISTED BELOW. I HAVE ALSO COMPLETED THE SAFETY TESTS THAT APPLY TO THE OPERATIONS AND EQUIPMENT LISTED.

MY SIGNATURE ON EACH OF THE LISTED ITEMS MEANS THAT I UNDERSTAND HOW TO PERFORM THESE OPERATIONS SAFELY AND I UNDERSTAND HOW TO USE THE TOOLS AND EQUIPMENT SAFELY. MY SIGNATURE ALSO MEANS THAT I AGREE TO USE ALL THE SAFETY PRECAUTIONS I HAVE LEARNED; I AGREE TO REPORT ANY UNSAFE CONDITIONS TO MY INSTRUCTOR; AND I WILL DISCUSS ANYTHING I AM UNSURE ABOUT WITH MY INSTRUCTOR.

DESCRIPTION OF EQUIPMENT OR OPERATION	DATE	STUDENT'S SIGNATURE	INSTRUCTOR'S INITIALS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

PARENT OR GUARDIAN NOTIFICATION

FROM:______________________________ DATE:______________________________
School

INSTRUCTOR:______________________________ STUDENT:______________________________

CLASS:______________________________ PERIOD:______________________________

SUBJECT: ACCIDENT PREVENTION

This notice is to inform you that ______________________ has repeatedly demonstrated an unwillingness to cooperate with the school's efforts to maintain a safe environment for the students and the staff of this school. Although all students are instructed in the procedures necessary to assure their safety and the safety of those around them, ______________________ has, on numerous occasions, chosen to ignore or violate these safety procedures.

If there is no improvement in attitude and in the level of cooperation, it may become necessary to restrict this student from further participation in class activities and projects. The result may be a failing grade or dismissal from this class. If you wish to have a conference regarding this matter, please so indicate below.

Please discuss this matter with ______________________, and sign this notice indicating that you, the parent or guardian, have read the notice and that you accept full responsibility and liability in the event of personal injury or property damage resulting from your son/daughter/ward's carelessness.

Parent/Guardian's Signature:______________________________

Date:______________________________

Yes, I would like to make an appointment to discuss this matter. I may be reached at ____________________ between the hours of __________
phone number
______________.

I have discussed this notice with my parent or guardian, and I understand clearly what it means.

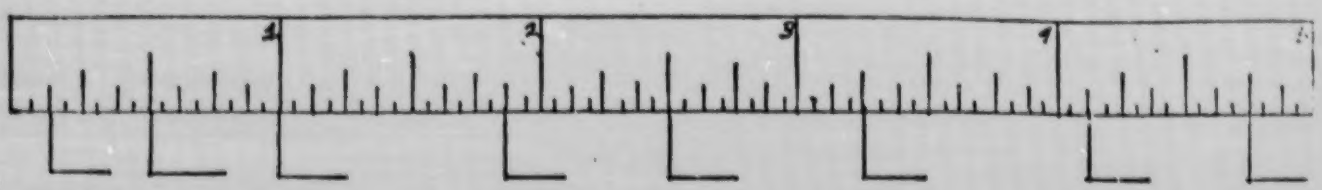
Student's Signature:______________________________

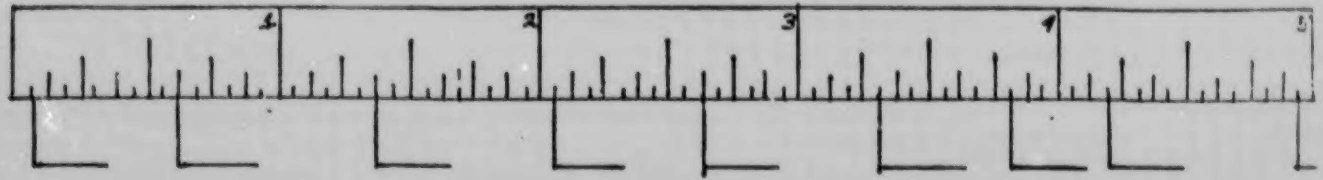
Date:______________________________

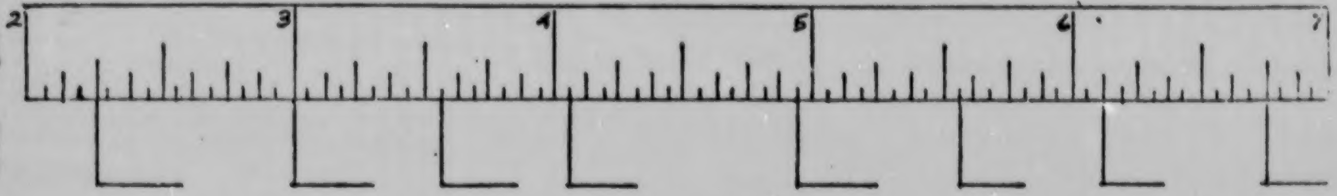
Copies of this notice have been sent to the office of the principal.

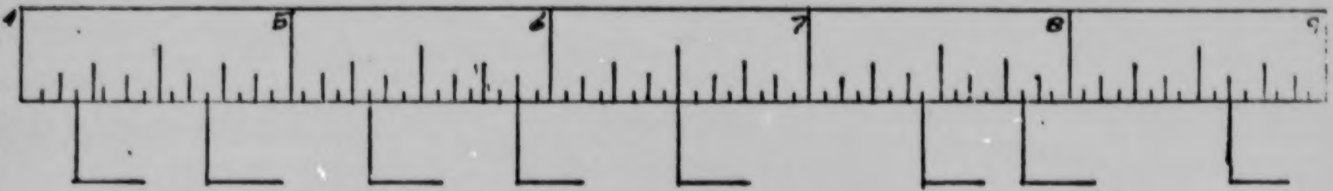
PARENT NOTIFICATION FORM 72

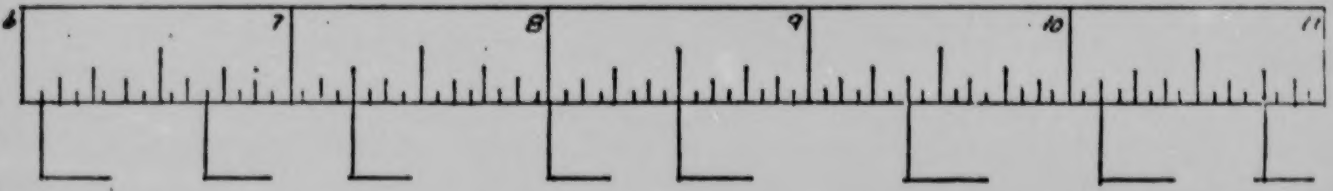
NAME: ____________

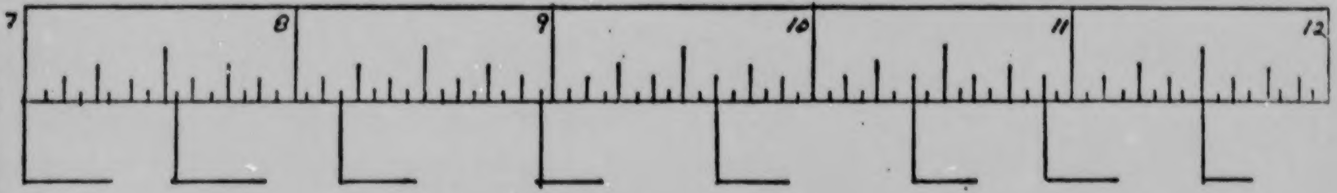


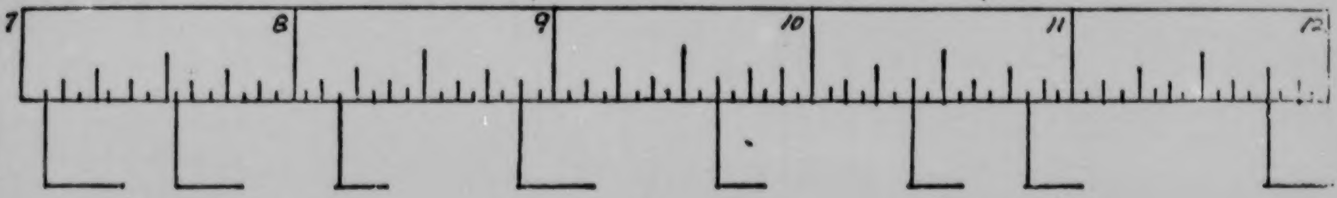












SOME OF TODAY'S INDUSTRIAL METALS

1. Aluminum - 1/3 weight of steel - 168 lbs./cubic foot, conductive, corrosive-resistant; used in aircraft alloys, wire, foil, and cooking utensils; melts at 1720° F.

2. Cadmium - Soft, bright, corrosive-resistant; used in solder, atomic-power control, and plating; melts at 1490° F; weight/cubic foot = 540 lbs.

3. Chromium - Bright, corrosive-resistant; used in stainless steels and plating; melts at 2940° F; weight/cubic foot = 443 lbs.

4. Cobalt - Used as alloy element in tool steels; oxidation resistant at red heat; melts at 2696° F; weight/cubic foot = 555 lbs.

5. Copper - Second in conductivity; ductile; used for electrical work and as alloying agent in bronze and brass; melts at 1981° F; weight/cubic foot = 558 lbs.

6. Gold - Most ductile and malleable; used in jewelry and coinage; melts at 1945° F; weight/cubic foot = 1206 lbs.

7. Iron - Most versatile structural metal; used in steel alloys; melts at at 2795° F; weight/cubic foot = 409 lbs.

8. Lead - Soft, toxic, high corrosion resistance; used in paints, radiation shields, gasoline, and alloys of copper and tin; melts at 622° F; weight/cubic foot = 708 lbs.

9. Magnesium - 1/3 lighter than aluminum; used in aluminum, zinc, and manganese alloys and chemicals; melts at 1204° F; weight/cubic foot = 1091 lbs.

10. Molybdenum - Most available high-temperature metal; used in steel alloys and high temperature forgings; melts at 4750° F; weight/cubic foot = 636 lbs.

11. Nickel - Most versatile alloy metal, corrosive-resistant; used in steel alloys and for electroplating; metals at 2646° F; weight/cubic foot = 555lbs.

12. Platinum - Highest resistance to corrosion; used in jewelry, alloys, electrical contacts, chemical equipment; melts at 3190° F; weight/cubic foot - 1333 lbs.

13. Radium - Radioactive; used in luminous paints and cancer treatments; melts at 1760° F; weight/cubic foot = 312 lbs.

14. Silicon - Most abundant metal, brittle, heat-, corrosion-resistant; used as ferro-silicon to add elasticity to steel and as high-temperature coating for steel and molybdenum; melts at 2590° F; weight/cubic foot = 151 lbs.

15. Silver - Highest thermoelectric conductivity; used in coinage, jewelry, silverware, alloys, and silver plating; melts at 1761° F; weight/cubic foot = 645 lbs.

16. Sodium - Soft, highly reactive with air and water; used in aluminum-silicon alloys, liquid-metal heat exchangers in atomic power plants, and in making tetra-ethyl lead; melts at 208° F; weight/cubic foot = 61 lbs.

17. Tin - Bright, soft, corrosive-resistant; used in solders, bearings, type metal, and plating; melts at 449° F; weight/cubic foot = 359 lbs.

18. Thorium - Radioactive, potential source of atomic energy; used to add strength to magnesium and life to heat-resistant alloys; melts at 3350° F; weight/cubic foot = 705 lbs.

19. Titanium - Lightweight, strong, corrosive-resistant; used in high-strength aluminum alloys, high temperature titanium carbides, nonstructural sheet in jet engine shells, ducting and fittings; melts at 3300° F; weight/cubic foot = 281 lbs.

20. Tungsten - Highest known melting point - 6100° F; used in steel alloys, lamp filaments, and plating; weight/cubic foot = 1204 lbs.

21. Uranium - Radioactive, fissionable, source of atomic energy; melts at 2071° F; weight/cubic foot = 1166 lbs.

22. Vanadium - Soft, corrosive-resistant; used to add toughness to tool and die steels, shafts, springs, and bearings; melts at 3110° F, weight/cubic foot = 372 lbs.

23. Zinc - Bluish-white, resist atmospheric corrosion; used in alloys of aluminum, magnesium, and copper, as well as for dry batteries and galvanizing; melts at 797° F; weight/cubic foot = 446 lbs.

INDUSTRIAL ARTS

I. Teacher Readiness

A successful first meeting with your students is important. The first impression of you as a teacher is a lingering impression. Most of the qualities that denote a good teacher will be required in handling your first encounter with a new group of students.

The chief thing to be tested, however, will be your ability to foresee, and your skill to prepare for that which you have foreseen.

As a check upon your readiness to meet the class for the first time, the following points may be of value:

1. Visualize the class as fully as possible, as to age, training, temperament, aptitudes, and the like. Previous records will assist here.
2. Be certain that equipment and tools are in perfect condition.
3. Have a definite plan for the work for the semester.
4. Have material on hand and ready for the first piece or pieces of work to be done.
5. Have a written lesson plan of procedure for the first class meeting.
6. Have the needed tools and other devices on hand for the first lesson.
7. Be ready to assign students to working places and lockers.
8. Plan a definite method for getting acquainted with the class.
9. Prepare to be glad to see the students arrive and to let them know it.
10. Have a definite plan for standards of order and discipline, and be prepared to put this plan in operation from the start.

Techniques for Maintaining Interest

The following suggestions are offered for maintaining interest and keeping it at a high pitch over a long period of time.

1. Call class together at the beginning of each period.
2. Have a definitely planned small unit of instruction ready for presentation for each class meeting before students go to work.
3. Make each presentation different from that of the day before. This can be brought about by difference in subject matter or in manner of presentation.
4. Use a variety of teaching aids both for instruction and for stimulating interest.
5. Draw upon popular magazines, motion pictures, newspapers, school shop magazine, etc. for examples of application to work which students are doing.
6. Rotate students' jobs in class maintenance at frequent intervals.
7. Indicate or present difficult, but interesting, problems for solutions by class, encouraging problem solving.
8. Use chalkboard sketches for stimulating interest.
9. Give recognition to students' effort. Do so often.
10. Keep a progress chart. Students like to see their degree of progress indicated by marks.
11. Let students assist in solving problems rather than simply telling them what to do.
12. Assign work so that each student can experience success.
13. Keep an atmosphere of joy and accomplishment in the class at all times.
14. Make the work of the class progress as rapidly as possible.
15. Use questions freely to stimulate thinking and sustain interest.

COURSE EVALUATION

Purpose:

This evaluation is an effort by your instructor to ascertain his teaching effectiveness and the usefulness of course materials. It is designed to provide suggestions on how the course can be improved and be made more relevant to students' needs. Your cooperation will be greatly appreciated.

Instructions:

Below are a list of qualities dealing with the course and the instructor. You are asked to evaluate these qualitites on a scale of four to one. Four is the highest ranking, and one is the lowest ranking. Any comments you wish to add may be included on the back of this sheet.

		Rankings			
		Highest		Lowest	
1.	The class sessions and lectures were well organized.	4	3	2	1
2.	The course textbook was very helpful.	4	3	2	1
3.	The course was interesting and enjoyable.	4	3	2	1
4.	The course material satisfied my educational needs.	4	3	2	1
5.	The tests used in the course contributed to greater learning.	4	3	2	1
6.	Material presented in the course was easy to learn and to apply.	4	3	2	1
7.	The instructor displayed a sense of professionalism and dignity in the class.	4	3	2	1
8.	The instructor seemed personable and genuinely interested in students.	4	3	2	1
9.	The instructor has a thorough knowledge of his subject matter.	4	3	2	1
10.	The variety of presentation methods was good.	4	3	2	1
11.	The instructor displayed a sense of humor.	4	3	2	1
12.	The instructor was clear in his explanation of course material and assignments.	4	3	2	1
13.	The instructor always seemed prepared for class meetings.	4	3	2	1
14.	The instructor was always well dressed.	4	3	2	1
15.	The instructor provided for all students to participate.	4	3	2	1
16.	The instructor was patient and resourceful.	4	3	2	1

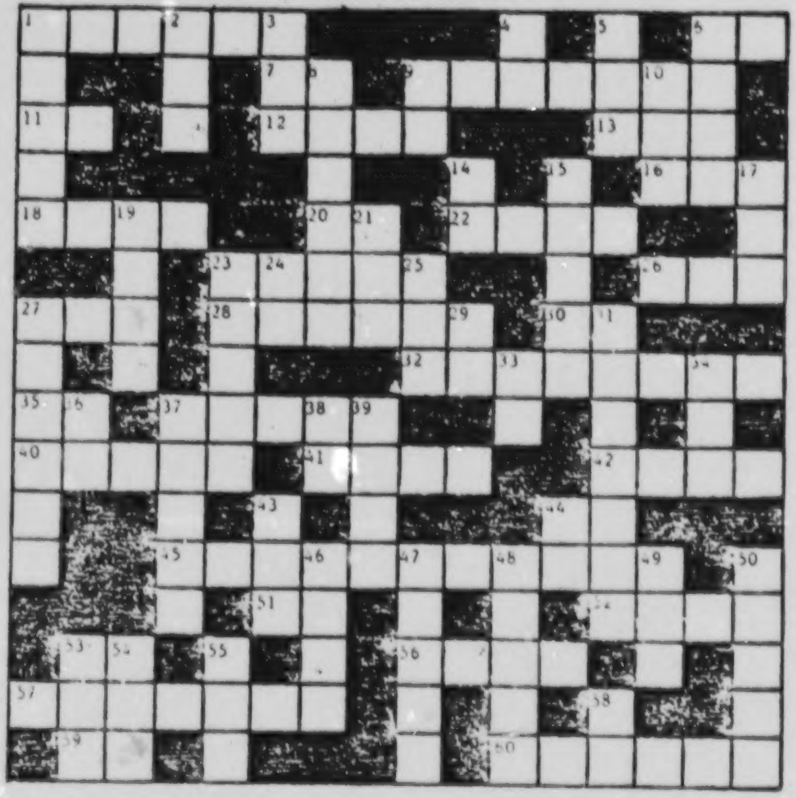
APPENDIX 2

CROSSWORD AND WORD FIND PUZZLES

BEST COPY AVAILABLE

Crossword Puzzle

MICHAEL R. KOZAK



ACROSS

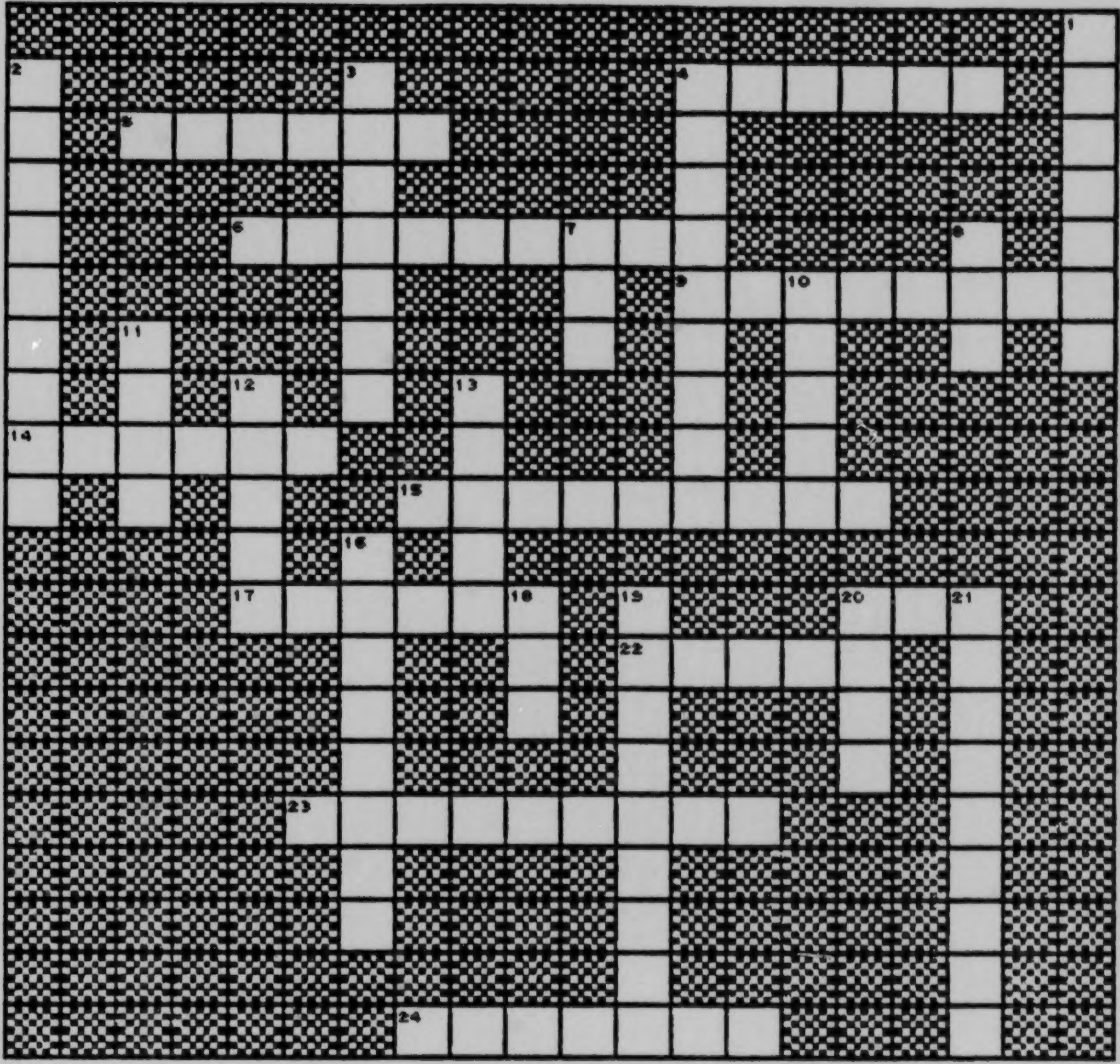
1. Side cutting ________
6. Practical education (abbr.)
7. Alternating current (abbr.)
9. ________calipers
11. National coarse (abbr.)
12. ________washer
13. National Institute of Education (abbr.)
16. Open- ________wrench
18. ________saw
20. Program of work (abbr.)
22. Wrought ________
23. Tool ________
26. ________stock
27. ________screw
28. High ________steel
30. Non brittle (abbr.)
32. ________key
35. Inside diameter (abbr.)
37. ________vise
40. ________pitch gauge
41. Finish a drilled hole
42. Protective coating on steel and iron
44. 3.1416
45. Chamfer a hole
51. Go ________college
52. Toothed wheel
53. Company (abbr.)
56. Goggles protect your ________
57. ________gauge
59. Technical education (abbr.)
60. Several twist ________

DOWN

1. Center ________
2. ________spanner wrench
3. ________-ammoniac
4. Industrial technology (abbr.)
5. Chief ingredient in pewter
6. Ball- ________hammer
8. Oldest metal known to man
9. All right
10. ________stock
14. Cast iron (abbr.)
15. Half- ________file
17. Layout ________
19. ________chisel
21. Thin metal sheet or rib
23. Machine ________
24. Teaching assistant (abbr.)
25. ________carbon steel
27. Flat ________
29. ________horseplay
31. Joining metals by fusion
33. Outside diameter (abbr.)
34. School is ________
36. Direct current (abbr.)
37. ________grinder
38. Cold-rolled (abbr.)
39. ________treatment
43. Wing ________
44. Production industries (abbr.)
46. Round ________chisel
47. Natural abrasive
48. High ________steel
49. Prevents pulley rotation
50. Copper-zinc alloy
53. Double- ________file
54. Iron ________
55. Society of Automotive Engineers (abbr.)
58. Dial indicator (abbr.)

METALS /

NAME: ____________________



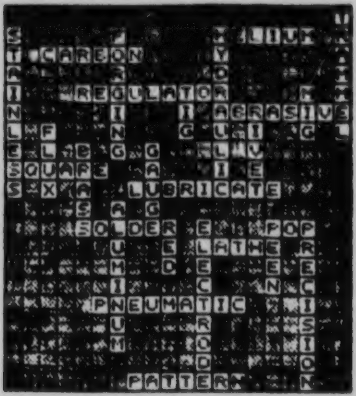
ACROSS CLUES

4. HOT INERT GAS
5. PLUS IRON MAKES STEEL
6. CONTROLS PRESSURE
9. SANDPAPER
14. 90 DEGREES
15. MAKE SLIPPERY
17. TIN AND LEAD
20. ____ RIVET
22. DOES KNURLING
23. AIR OPERATED
24. TEMPLATE

DOWN CLUES

1. DRAWS LARGE ARCS
2. RESISTS CORROSION
3. DONE ON AN ANVIL
4. FLUID OPERATED
7. TUNGSTEN INERT GAS WELDING
8. METAL INERT GAS WELDING
10. FASTENER
11. CHEMICALLY CLEANS
12. COPPER AND ZINC
13. THICKNESS LESS THAN 1/4 INCH
16. NON FERROUS METAL
18. FIRE SAFETY EQUIPMENT
19. ROD
20. HAMMER
21. ACCURACY

ANSWERS: METALS I


HELIUM
CARBON
REGULATOR
ABRASIVE
SQUARE
LUBRICATE
SOLDER
POP
LATHE
PNEUMATIC
PATTERN
STAINLESS
PRECISION

GENERAL WELDING PUZZLE

ACROSS

1. Intimate mixing of molten metal
4. Weld deposit left after a weld pass
5. Type of inspection done with no equipment
8. Historical event that accelerated the development of MIG and TIG
10. Bottom of weld
11. Welding position
12. Type of joint
13. Welding position
15. Flow of electricity through an air gap
16. Depression at the toe of a weld which is below the surface of the base metal
19. Fusibility is the ease with which metal will _______________.
20. Welding has two major functions--fabrication and_______________.
21. To separate metal
22. Type of weld used in T-joints
25. Direct current
26. Used to mark layout lines on metal
27. Fuel, heat, and oxygen produce_____________.
28. Zn
30. Penetrant test (abbr.)
31. Nondestructive testing (abbr.)
33. Electroslag welding (abbr.)
34. Type of weld bead made without transverse oscillation
36. Alloy of tin and lead
38. Nickel (symbol)
40. Welding goggles protect these.
41. ______Welding is a form of resistant welding.
43. Welding position
45. Welding in a joint that lacks fusion
46. TIG
47. Acetylene, propane and Mapp
48. Interchangeable heads of torch handle
49. Nonmetallic layer that forms on the top, of a weld
51. Beveled opening provided between two metals to be joined
52. Nonmetallic matter trapped inside the weld
54. Distance down from the surface of metal to where fusion ceases
58. Shielded metal arc welding
59. American Welding Society (abbr.)
61. MIG
62. Never used to lubricate regulators
63. Used to ignite gas
64. Mixture of iron and carbon

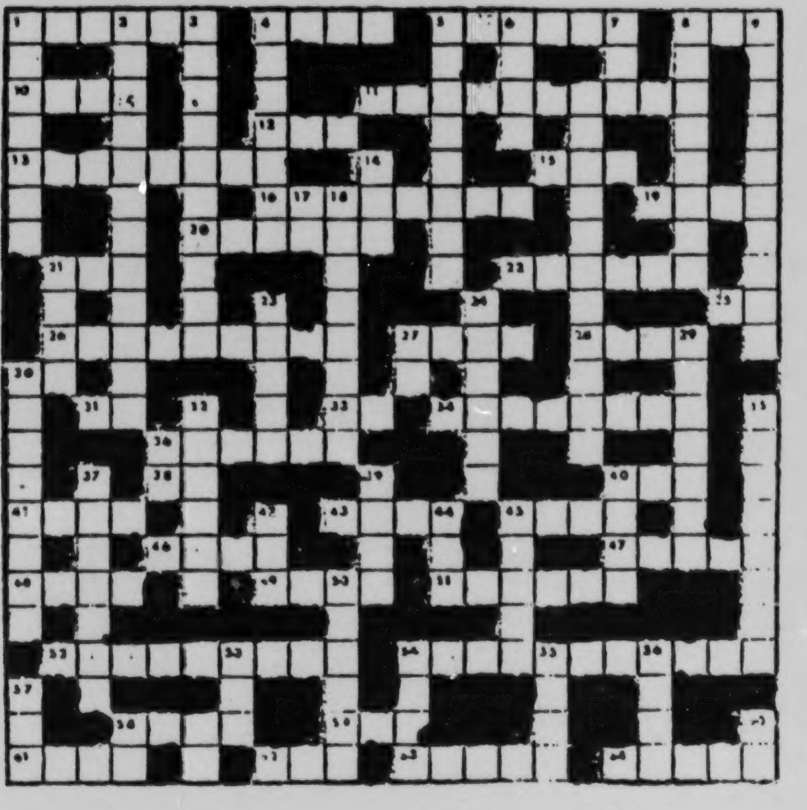
DOWN

1. Metals containing iron
2. Weld that is not continuous
3. Metal that does not contain iron
4. A sequence of weld bead, one on top
5. Welding position
6. The ____ of the tip is determined by the diameter of the opening at the end.
7. Liquid penetrant test (abbr.)
8. Assembly whose parts are welded together
9. Opposition to electron flow
14. Cubic feet ____hour
17. Not available (abbr.)
18. Cross-sectional measure of rod
21. Three forms of iron--steel, wrought, and _______.
23. Cylinders are _______ in cross-sectional area.
24. Depression at the end of the weld bead
27. Iron (symbol)
29. Where three sides of a piece of metal meet
30. Presence of voids in the metal or weld
35. Act or condition of sticking together, fusion
36. Tin (symbol)
37. Pieces of metal to weld together for testing or practice
39. Type of weld done in a hole
40. Type of joint
42. American Welding Society (abbr.)

GENERAL WELDING PUZZLE (Continued)

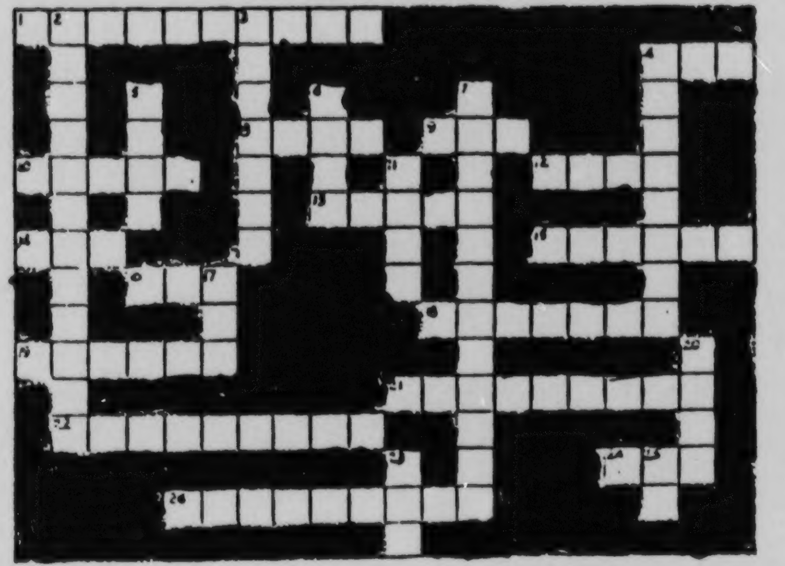
DOWN

44. GTAW
45. When not in use, _____ the cylinder valves.
50. To soften metal
53. Submerged arc welding (abbr.)
54. Longitudinal progression of a welding operation
55. Type of temporary weld
56. A bend __________ is a type of destructive testing.
57. GMAW
58. Stud welding (abbr.)
60. Aluminum (symbol)



Machine Lathe X-word Puzzle

By Earl O. Hagen



DOWN

2. TPF
3. Blanks, for gears are mounted on a ____for turning and facing.
4. Knurling is done with a ___tool.
5. The compound ____ holds the tool post.
6. V-shaped tracks on the bed are called _____.
7. Feeding the tool along the workpiece is called ____feed.
11. Centers with bearings are called _____centers.
17. The half____lever is used for thread cutting.
20. A cone pulley uses a ____ belt.
23. The lathe ____ is the long part that rests on four legs.
25. Mount the tool bit with its cutting edge ____line with the centers.

ACROSS

1. A taper ____may be used to turn a taper.
4. A chuck____tightens the workpiece in a chuck.
8. The type of center that does not turn.
9. Use a faceplate and a ____ when turning between centers.
10. To face-off a workpiece you ____feed the tool bit.
12. The ____box transmits power to the lead screw.
13. The ____of the lathe determines the size.
14. Never leave the chuck____in the chuck.
15. Turning and _____are operations performed on the lathe.
16. The bull-gear ____pulled out to use the back gears.
18. A machine tool is used for ____ metal.
19. A ____chuck needs a draw bar.
21. Three jaw ____ chuck.
22. The part of the lathe that has set-over screws.
24. A tool ____cuts the rotating stock.
26. The apron ____is used for manual movement of the carriage.

WORD SEARCH

NAME ______________________

PERIOD ____________________

```
T Y S B O B O D Y S H O P L S A I A S A N G
R G R E C O N S T R U C T I O N Y W E L D I
U O M I A I A J C K T E C A H N T G R A P H
C L E N E R G Y G I O E L S P R I N T I N G
A O T U W A S N C G N G N A Y O C F T H E P
I N A I I H I C A N M O Y I G N I T N I A P
P H L C H T Z R R I M E R A B R R S H A O L
L C W K F C C N P T A N I T F A T V E W V A
U E O A O T O M E C H A N I C S C L E D C S
M T R M A C H I N E W O R K O E E R R P A T
B D K A S A M I T I S Y E N I D L E W O T I
I J I N D U S T R I A L A R T S E E E W R C
N A N E V E R T Y O N S T E G R A P H I C S
G Y G N I K R O W D O O W A E R O S P A C E
A A I R C O N D I T I O N I N G A U T A M E
```

Industrial Arts
Metalworking
Woodworking
Drafting
Auto Mechanics
Power
Energy
Welding
Electronics
Electricity

AIASA
LIASA
Plastics
Graphics
Air Conditioning
Carpentry
Cabinetry
Aerospace
Technology
Machine Work

Printing
Plumbing
Painting
Body Shop
Construction

*DIRECTIONS: Find the listed words in the puzzle above.

CLUE.......Search all directions.

Metals - Word Search II   Name____________________ Period__________

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P E N N D A E R H T O C R Y O L I T E O X I D E X T E R
R E F L E X I B L E W T I G E R S N I R R O K S T O P S
O P D U C T I L I T Y E B M A N G A N E S E L A S T I C
P H Y S I C S O S T E N B I X Q E L I F B L O L S A T A
E T E C H N O L O G I C A L I M O L Y B D E N U M P C N
R U E K H N S O L I D D U L S E M E O U S C A M B E H N
T N K O N S I L I C O N X W O A A A G N A T O I P R E O
I G E L I T N T D I T H I R R R U B R O W K O N D A K B
E S T L O N E T I G S Y T I E Z L L L A N O G A T C O S
S T Y A N O R O F O G D E G O M A E R O S L O G I S T R
O E X F E X T D I R E R E H S A W A R E L Y E V E R T E
C N D O R N A M E N T A L T O N T O A T O T R A M M E L
U O E R H L O A S T D U F F I E S M A C K I L N O U N I
P U R G E C D O L M O L D I A M E T E R T C O A U N O X
O D K I O K E W P I X I O Z C P S R Y K G O O D B T H L
L C T N P E W T E R I C S T M X U O C H R O M I U M S O
A G A G E L O U S T D B T Y E O W D N A I T B U R N I N
S O C K E T E X T O A R E O L R E S R A T T E M N O N E
I L R W X I N D U C T I O N O E T D R I R A I D O A A R
L D E Y O N D E D O I T D I A G O N A L L O P I C K L E
V E S Z T O G G L E O T A N Y O P C A L L L V E R B P N
E C T L O B U B B L N L N O L E Y X A O E N A M E L O G
R E L L I P S E A T Y E T U L F H X Y S Z F L A N G E E
O N A E T I D O H P A M R E H O N P L A T I N U M B E R
```

Technological
Solidifies
Millwright
Ornamental
Forging
Hydraulic
Mold
Purge
Malleable
Gage
Silicon
Manganese

Oxidation
Induction
Chromium
Nickel
Vanadium
Tungsten
Inert
Molybdenum
Ductility
Brittle
Elastic
Socket
Diameter

Pitch
Helix
Acme
Thread
Creast
Axis
Hypotenuse
Taper
Ream
Flute
Seam
Pewter
Tin
Gold
Silver

Platinum
Oxide
Bauxite
Ore
Alumina
Cryolite
Properties
Electrolytic
Cupola
Trammel
Dye
Hermaphodite
File
Burr
Ellipse

Octagonal
Tang
Diagonal
Flexible
Bolt
Stud
Washer
Grit
Schroll
Planish
Enamel
Kiln
Pickle
Drill
Cast

BEST COPY AVAILABLE

METALS PUZZLE 1 A

```
O G K G D U M G X E M M J S I H U R A D I O G R A P H Y T T B E
F O E A J S L X K Q U T O P Y F T L J H H T M C F U Y H S R I C
N B E I F H A P A C S G T Z G X R L P I P U L F P P Q R Z Z S A
K T K G I G F U I T H E W I H T U A Q I M S Y P Q C E E R K B S
R O T A L U G E R R W A T U U B O L D R C U M I H D E Z I I A Y
V M D U Y C N E U Q E R F Q R P V C T D F Q Z A I R G I K Q Q B
M D Y I U S N O Z T W T W I S J Y Q Z H W M D V N Q B G C O Y V
A C E T Y L E N E B A W C C C Y R T N K T N I I T D N E N J T Y
F A V U F Y T Y Z D Z A I H Y E I M M W U D U P F I R F I S C O
O M J A K V S A R Q N R P I T E F N U O S E X T R Q B E Z H E B
V S B F M G G K B T F J X N V I K X S U S Q C E J W S V L D O W
E A V M G P N N S A A V E U A B X A Q G W C P A A A G F V H S V
W L P E G K U U X B E C K M E S R D D N F M C D N W O A N V I L
D P I N V M T R R R G Z X D X T S B R L E I J C J R P D D N X X
V D X I J D D L N T W E O L L T F E M T T G E D G J U X C H U T
L F O W O F B I P F V R E U K M T K D A I T N E P G J F A B L C
W C J I K K E I L U T E B H W T G W M P N T X A G K U M L J E G
I G N V F R N Z E C N W K B A T X U B X C L A M L D E H I U H A
N W N E F S A F E T Y C R P P X E R W R L W G N P F M K P I W T
W S L G H Z K L P R T E H X Y N X T R J O H G Y I K X C E P O T
R E M P H J E V M A T N K H P B Q B T Y S N U A Y U B U R Y P A
Z N W T C H G D I E O M E N H J C J W Z R G Z Z O L M H Q F T I
A L F C V H N L M I L E S I H C T C I N B D S E H Z A C I Q O F
Z C Y Y H L S O S O V S R H E L B I C U R C N T E O R T T U F I
W B F L Q T R I K D T B F V E V K A J O R Z B U R S A A H A A E
B A L B O C C R G A I Y R S P E K A H V S T O H O A I G M E V Z
F H U C I E Z W I Z T P S A H M T U V B G S S R A F M R S N A E
F X K M R L I N T Q B S L M S Z X M S K X T R C G Q V M A S I Y
Y D Q P S A L C O P P E R N W S O D E H A U A W I R E K E K M G
X Y S C O E L L N M Q D Z N Z S C M P T Z B E M L V L X D L O L
H S R Y S I Z B Q A T Y V M T R O A E N A D H E R A U Q S T Q L
Y S D S B W T X W U G E I W M Q L B J J Y L S M M G F J A V P B
```

THERE ARE 45 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ACETYLENE
BRASS
CALIPER
CHISEL
COPPER
DIE
ELECTRODE
FORGE
FREQUENCY
GEAR
LATHE

ANVIL
BRONZE
CENTER
CHUCK
CRUCIBLE
DIVIDERS
FLANGE
FOUNDRY
FURNACE
KNURL
LUBRICANTS

MANDREL
PATTERN
PNEUMATIC
PUNCH
REGULATOR
SHEARS
SQUARE
TAILSTOCK
TITANIUM
TUNGSTEN
VERNIER
ZINC

MICROMETER
PLASMA
PRECISION
RADIOGRAPHY
SAFETY
SHEETMETAL
STAINLESS
TEMPERING
TRAMMEL
ULTRASOUND
WIRE

CIRCLE WORDS IN PUZZLE ABOVE.

NAME:____________________________

WORDS MAY BE HORIZONTAL. VERTICAL,
DIAGONAL, FORWARD, OR BACKWARD.

Solution

METALS PUZZLE 1A

```
. . . . . . . . . . . . . . . . . R A D I O G R A P H Y .   . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . S . . .
. . . . . . . . . . . G . . . . . L . . . . . . . . . R . . . .
. . . . . . . . . . . E . . . . U . . . . . . . . . E . . . . .
R O T A L U G E R . . A . . . B . . . . . . M . . D . . . . . .
. . . . Y C N E U Q E R F . R . . . . . . . . A I . . . . . . .
. . . . . . N . . . .   . I . . . . . . . . D V N . . G C . . .
A C E T Y L E N E . . . C . . . R . . . . N I . . D N . N . . .
. A . . . . T . . . . A . . . E . . . . U D . . . I R . I . . .
. M . . . . S . . . N . . . T . . . . O . E . . R . . E Z . . .
. E . . . . G K . T . . . N . . . . S . . . C E . . . . L . . .
. A . . . . N N S . . V E . . . . A . . . . P A . . . F . . . .
. L . E . . U U . . E C . . E . R . . N . M C . N . O A N V I L
. E I . . . T R . R . . . D . T . . R . E I . . . R . . . . . .
. C . . . . . L N . . . O . L . . E . T T G . . G . U . C . . .
. . . . . . . I P . . R . U . . T . . A I . N E . . . F A . . .
. . . . . . E . . U T . . . . T . . M . . T . A . . . . L . . .
. . . . . R . . . C N . . . A . . U B . . . A . L . . . I . . .
. . . . . . S A F E T Y C R P . . E . . R . . . N . F . K P . .
. . . . . . . L . . T E H . . N . . . . O . . . I . . C E . . .
. . . . . . E . . A T N . . P . . . . Y . N . . . U . U R . . .
. . . . . . . . I E O . . . . . . . . . R . Z . . L M H . . . .
. . . . . . . L M I L E S I H C . . . . . D . E . . A C . . . .
. . . . . . S O S . . S . H E L B I C U R C N T . . . T . . . .
. . . . . T R I . . T B . . E . . . . . . . . U R . . . H . . .
. . . . O C C . . A . . R . . E . . . . . . . . O A . . . E . .
. . . C I E . . I . . . . A . . T . . . . . S . . F M . . . . .
. . K M R . . N . . . . . . S . . M . . . . R . . . . M . . . .
. . . P . . L C O P P E R . . S . . E . . . A W I R E . E . . .
. . . . . E . . . . . . . . . . . . . T . . E . . . . . . L . .
. . . . S . . . . . . . . . . . . . . . A . H E R A U Q S . . .
. . . S . . . . . . . . . . . . . . . . . L S . . . . . . . . .
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METALS PUZZLE 1 8

```
G G H L G P L L S U N K C X J R O F U O E N O N T U G V J H S Y
Z L U I G E Z Y S S U G L U C L Q P H C R K M T C B H V Q O H D
J U J O T F E C T Q J I X X D O Z P E O A I Y P V T G X Z P E I
K I Q L H W Y J K M U S G W R E T I T W U A R C U A E I A I E C
C B A B K U V J K C W H C V N U S C C O Q A N U Y Y F R U Q T W
P H L O K E G S E K I O Y C O K B I L J S I X V Y L G G L H M K
C Z Q N R F V N M I D E Y G F K R E W A Z R B V A O E W T K E W
I Q P N V V T D C G A Q D G E S R H J H E E R N I A Q L R A T P
G A I Q S E V I T O A M R O E T A E E P X U G D R B B G A B A R
D E X L R J T S P S O M G H S A C R P R O E A T R Z C F S P L E
R O P P T A R H P X H D T S Q I E O O I I R B H S V I O O C V C
R M I E M E U T A L K A A T F N C S E T L W G R E U P U U I S I
R J C U D L I C T E L S R D E L N A A D A A V A R W T N N W B S
G V E I R T S V T S G A T W G E J Q N F O L C Y S N U D D J O I
Z N V U A R Q K E I W G O N T S Y T T V E R U Y J A E R X W K O
P I N N A M Q R R H N A D S A S B R R V I T T G B K F Y J V H N
D K I E X F V E N C C E G C R C P B L Y A L Y C E X T X Z L V A
Z U H U G B S H H X S N G E Z G I E G T K Y W T E R X U H L F O
M S Y P R C X P F C U Q Y K N Y R R T Q M R B A Q L X L V A L N
C H Y O C M O H F T D L Y X J E G J B L X M L I A L E R D N A M
P R N T W H C W G B H K G Y D L L K B U S U R L M S I L G P I Y
F Z U H R N U O U O F O W V I D K Y Y S L D Z S T Z H F W N J F
E O M C U A I C X P D U S T A R C O T D T I K T E X A Y T Y Y F
R C R P I P M J K I T Y Q Z O I T L G E I N X O M P L A S M A R
A J A G O B D M I P X V T J L J O W N L C E W C P H B V G X T K
D P F N E C L A E H Y R E T E M O R C I M A V K E V U Y J H K H
H W S A R D C E T L X I N B F H X D H X H V K F R E Q U E N C Y
C O E B W U L C Z J I S H O I O R U S B W P M J I B J F O E Z I
P N M V E U F D C I K Q Y F O U L O R C B X J D N M R Z Y Z M I
X U E E E H H I S M Z T W V J U H B M N T C L P G W P A Z E J M
W J J H W Q S O S C F G W Y S M O D K G R G U Y W O J X S F V F
E W A V M B N K M E F M L X M S K I W P P K K O A I O R F S H H
```

THERE ARE 45 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ACETYLENE
BRASS
CALIPER
CHISEL
COPPER
DIE
ELECTRODE
FORGE
FREQUENCY
GEAR
LATHE

ANVIL
BRONZE
CENTER
CHUCK
CRUCIBLE
DIVIDERS
FLANGE
FOUNDRY
FURNACE
KNURL
LUBRICANTS

MANDREL
PATTERN
PNEUMATIC
PUNCH
REGULATOR
SHEARS
SQUARE
TAILSTOCK
TITANIUM
TUNGSTEN
VERNIER
ZINC

MICROMETER
PLASMA
PRECISION
RADIOGRAPHY
SAFETY
SHEETMETAL
STAINLESS
TEMPERING
TRAMMEL
ULTRASOUND
WIRE

NAME:______________________________

CIRCLE WORDS IN PUZZLE ABOVE:
WORDS MAY BE HORIZONTAL, VERTICAL,
DIAGONAL, FORWARD, OR BACKWARD.

SOLUTION

METALS PUZZLE 18

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. . . . . . . . . . . . . . . . . . . . E . . . . . . . . . S Y
. . . . . . . . . . . . . . . . . . . . R . . . . . . . . . H .
. . . . . . . . . . . . . . . . . . . . A . . . . . . . . P E .
. . . . . . . . . . . . . . . . . . . . U . . C . . . . A . E .
. . . . . . V . . C . . . . . . . . . . Q . N . . . F R U . T .
. . . . . E . . E . . . . . . . . . . . S I . . . L G G L . M .
. . . . R . . N . . . . . . . . . . . . Z R . . A O E . T . E .
. . . N . . T . C . . . . . . S R . . . E . . N I A . . R . T P
. . I . . E . I   . . . . . E T . E E P . . G D R . . . A . A R
. E . . R . T S . . . . . H . A . R P R . E A   . . . F S . L E
R . . . . A R . P . . . T . . I . O O I I R . . . . . O O . . C
. . . . M E . T A L . A . . . N C S E T L W . . . . . U U . . I
. . . U D L I . T E L S . . . L N A A D A A . . . . . N N . . S
. . E I R T S . T S . . T . . E . . N F O L C . . . . D D . . I
. N V U A R . . E I . . . N T S . . . V E R U . . . . R . . . O
P I N N A . . . R H . . . S A S . . . . I T T G . . . Y . . . N
D K I E . . . . N C . . G . . C . . . . . L Y C E . . . . . . .
. U H . . B . . . . . N . E . . I . . . . . . T E R . . . . . .
M S . . R . . . . . U . . . N . . R . . . . . A . L . . . . . .
C . . O C . . H . T . . . . . E . . B . . . . I . L E R D N A M
. R N T . H C . . . . . . . . . L . . U . . . L . . . . . . . .
F Z U . R N U . . . . . . . . . . Y . . L . . S T . . . . . . .
E O . C U A . C . . . . . . . . . . T D . . . T E . . . . . . .
. C R P I . M . K . . . . . . . . . . E I . . O M P L A S M A .
. . A G . B . M . . . . . . . . . . . . C E . C P . . . . . . .
. . . N E . L . E . . R E T E M O R C I M A . K E . . . . . . .
. . . . R . . E . L . . . . . . . . . . . . . F R E Q U E N C Y
. . . . . U . . . . . . . . . . . . . . . . . . I B . . . . . .
. . . . . . F . . . . . . . . . . . . . . . . . N . R . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . G . . A . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . S . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . S . .
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GENERAL SAFETY TERMS #1

```
E X O A F U W K F F C L D K D G U Q Z J F Y C U K F D U A I H K
X E W I A T Y O S L S I Q R E W C B O P L A Z K O F E B L K W G
F K I G A F Q K Y A V Y M N T D I D G Z H W M U L F G J W J R H
F W S I M H H G F O I I S E K N Q Z B O K E T T H V R H E K H D
M G H P B U E E K U O O J X S G F O S I C O F O G N L J Y E O Z
D V F T T Y T A V U H J H W T U L W X X E K Y S O A Y T N U W M
K P A J Y Y J O T Z P H J Z O C A P D U S T E F I D N I Z P H Z
K L G W U S W R X N V V W F R S M O C Q I E I D S O H I X Z G U
X F T N V U T I E K Q J A K A H M S H R O J J H I C Z G K F V B
J G E S F E P U Q B B Y L M G S A T I Z N P O T A C Y O E L D O
H L T Y A J A I D O K J D N E A B E P F R P A M Y F R Y J V Y W
C O H O U S E K E E P I N G B F L R S A G L M T X O Z O N R B L
U W R E Q U I P M E N T Y N I E E S H Q I N E Y N U A I L G B D
M B R S S R R U B J H T X J N T R S T T Y O I G I D H V R O U T
I U U W E O H W C Q H F S B S Y I D N G F B P N A G P I F R C K
I T R H X P S L O O T U T V V L B E N P X X O I A R E Q A X V G
R Y A O T J L D V U X N E E W I V H W M O N U W Y E O R J G R X
G N I T T U C A N F P L S G M N R O T A R I P S E R L T N T O C
J Q S X T E H O Y S C A W H J E O G C A I P H T S Y E C S O T H
R V J X N A F R U L E S B R T S M X N T D W Y S H O P K D X C K
E P U A L C W O T A J Y R O S N I F O F I U E Y O V Z U J I U T
W T W N A U D E B Q Y K E G N I T H G I L M S K C U C Y K C R Y
O C E T W R W N K Y V S L O Z Z R H A U U A F T K D Z G X M T Y
P A B H A F B N R H X M E J I Y X I Q F O H L M R U C S W N S S
K I Q Z D S Q O R A A S C D X O R T F D D W N B R N H Z K Y N P
M H A I V J T A I R Y J T G B Q P U L M T Y I Q D F K R Y F I O
R H H J N A N Q G M F I R N I O S T N E M T S U J D A T L V F W
A I W E R T R Z N F U N I W Y S C D C E M E R G E N C Y W U X T
Z Y O O G V R Y R U A J C W Z O Q V A P O R H Z N E D Y C B J V
C V B H B E M F Z L Z U I U O U X U C U I O P G V E N V B G P X
G A Y T A X A F V L M R T Y V A E H D K M U U Q V O F E Z O L H
L D J G A L X A B D P Y Y M M C M X I V H W M M R O N R C T I V
```

THERE ARE 40 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ADJUSTMENTS
CHIPS
COLORCODE
DUST
EMERGENCY
FLAMMABLE
HARMFUL
HEAT
HORSEPLAY
INJURY
LABORATORY
MACHINE
POSTERS
RESPIRATOR
SAFETY
SHARP
SHOP
STORAGEBINS
TOOLS
VAPOR
BURRS
CLEANING
CUTTING
ELECTRICITY
EQUIPMENT
FUMES
HAZARDOUS
HEAVY
HOUSEKEEPING
INSTRUCTOR
LIGHTING
NOISE
POWER
RULES
SAFETYLINES
SHOCK
STORAGE
STUDENTS
TOXIC
VENTILATION

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME: ______________________

GENERAL SAFETY TERMS #1

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . S . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . A . . . . . . . . . . . . . . . . . . . . . .
. . . . . H . . F . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . E E . . . . . . S . F . . . . . . . . . . . . E . .
. . . . . . T A . . . . . . T . L . . . E . . . . . . . N . . .
. . . . . Y . . T . . . . . O . A P . . S . E . . . N I . . . .
. . . . . S . . . . . . . . R . M O C . I . . D S O H . . . . .
. . . . . . T . . . . . . . A . M S H . O . . H I C . . . . . .
. . . . . . . U . . . . . . G S A T I . N P O T A C . . . . . .
H . . . . . . . D . . . . . E A B E P . R P A M . . R . . . . .
. O H O U S E K E E P I N G B F L R S A G L . . . . . O . . . .
. . R E Q U I P M E N T . . I E E S H . I N E . . . . . L . . .
. . . S S R R U B . . T . . N T . S . T . . I G . . . . . O . .
. . . . E . . . . . . . S . S Y . . N . . . . N A . . . . . C .
. . . . . P S L O O T . . . . L . E . . . . . . A R . . . . . .
. . . . . . L . . . . . . . . I V . . . . . . . . E O . . . R .
G N I T T U C A . . . . . . . N R O T A R I P S E R L T . T O .
. . . . . . . . Y S . . . . . E . . . . . . . . S . . C S O T .
R . . . . . . R U L E S . . . S . . . . D . . S H . . . . X C .
E . . . . . . O . . . . . . . . . . . . . U E . O . . . . I U .
W . . . . . D . . . . . E G N I T H G I L M S . C . . . . C R .
O . . . . R . . . Y . . L . . . . . . . U . . T K . . . . . T .
P . . . A . . . R H . . E . . . . . . F . . . . . . . . . . S .
. . . Z . . . O . A . . C . . . . . . . . . . . . . . . . . N .
. . A . . . T . . R . . T . . . . . . . . . . . . . . . . . I .
. H . . . A . . . M . I R . . . S T N E M T S U J D A . . . . .
. . . . R . . . . F . N I . . . . . . E M E R G E N C Y . . . .
. . . O . . . . . U . J C . . . . V A P O R . . . . . . . . . .
. . B . . . . . . L . U I . . . . . . . . . . . . . . . . . . .
. A . . . . . . . . . R T Y V A E H . . . . . . . . . . . . . .
L . . . . . . . . . . Y Y . . . . . . . . . . . . . . . . . . .
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134

GENERAL SAFETY TERMS#2

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G B G R S S Y W U J R Q E L H N C C W A B X X Q E V C O D T Z T
T C U E D U I G S O Z Y V F Z X N W R Y X P R G H K S G X Z F B
I H L C E N K C I S R E S O G G G R C B H O U S E K E E P I N G
L U G F S A P Z I Y Q C B K G F R P E P R O T A R I P S E R M H
R S N N M Z G V O V H N E C Z Y L G X T J G C B D E T Y L Y B Z
F Z W Z J O V B W L A Y E G N M R P O K E J K Z I Z T T R T I J
A C I X W C U B A Q X U C X U J L X Q S Y I J D K E R U G T Z T
T B K K I K A M K G C W X T U E U K S X R M U G F G J D Z X U O
B E Q X D A D F P C D X Y X L F F G A C F C Z A R N Z W B X C X
Q R G L G X J L X J O G K B X D M I P J M W S I I F U M E S G I
I I X K K R U U L H P H A E M O R V U Q Y C B X E B Q T P B N C
Y S Q I C K S I E O J M S U R T A S T U D E N T S U R J U B I G
T H F V L D T Y S Z M W J E K P H B H Y J E Z E I Q Y I S W N M
T O X I S G M T D A T P I G S S H L Z C B O W W S L M M X S A O
X P S R J G E J L O L Y E A A K W N H T A N S E Z I B R D E E K
L G R V H R N F O A U N P R J S T E S N I B E G A R O T S N L F
K U M W S Q T L B I I R L O H S H Q U L I G H T I N G N U I C Y
B P M W E W S O L H A Y T T E Y B U H E A V Y I F L O A R L U A
V W V X M D R D C H C E W S V B Z I G R T P Q M W V P K E Y I K
H E L I R A O A S N J C G E M I E P R O T C U R T S N I W T S H
O O T P T Y M C E Z E D N B C K Q M C R H C B C I S L X O E R E
R V C O X C F G R Y T T C I R T C E L E H M Y U Q T V G P F X K
S C R U S T R H R O I L X B T X G N V I M C M R S R M I G A U B
E Y F K T E R J K L L C E Q T J H T P L C R E B U B A E O S Q G
P I U M M T G I A H R O X D F E S S T V Q C X F K Z U T B N O R
L J F E T Z I T T O N J C S D H T E Z A C Q Y G N A H O M Z F R
A C B T R A I N P N H V O B E K Q J O P A X M Q Z E H J D A Y A
Y X F O O O E A G W T E D B N Z P M M K U P T N E I G U G W W G
R O G U N B V H B E K D Q E I K B E H P R R M A P K Z Q W O Y Z
Y G Y J J P O X J S B R F R K Q V N C A Z F S X C Z D H X E J F
A P F W G W A J P W P X R S N Z O A P S U O D R A Z A H N J N I
S Y O G O T F U V T B D O A F D U S T T B W N Y S K V S U M Q U
```

THERE ARE 40 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ADJUSTMENTS
CHIPS
COLORCODE
DUST
EMERGENCY
FLAMMABLE
HARMFUL
HEAT
HORSEPLAY
INJURY
LABORATORY
MACHINE
POSTERS
RESPIRATOR
SAFETY
SHARP
SHOP
STORAGEBINS
TOOLS
VAPOR

BURRS
CLEANING
CUTTING
ELECTRICITY
EQUIPMENT
FUMES
HAZARDOUS
HEAVY
HOUSEKEEPING
INSTRUCTOR
LIGHTING
NOISE
POWER
RULES
SAFETYLINES
SHOCK
STORAGE
STUDENTS
TOXIC
VENTILATION

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR **BACKWARD.**

NAME: ____________________

GENERAL SAFETY TERMS#2

```
. . . . S . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . E . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . L . . . . . . . . . . . . . . . . . H O U S E K E E P I N G
. U . . . . . . . . . . . . . . . . . . R O T A R I P S E R . .
R . . . . . . . . . . . . . . . . . . . . . . . . . . Y . Y . .
. . . . . . . . . . . . . . . . . . . . . . . . . . T . R . . .
. . . . . . . . . . . . . . . . L . . . . . . . . E . U . . . T
. . . . . . A . K . . . . . . E U . . . . . . . F . J . . . . O
. . . . . . D . . C . . . . L . F . . . . . . A . N . . . . . X
. . . . . . J . . . O . . B . . M . . . . . S . I F U M E S G I
. . . . . . U . . . P H A . . . R . . . . . . . . . . . . . N C
. S . . . . S . . O . M S . . . A S T U D E N T S . . . . . I .
. H . . . . T . S . M . . E . . H . . . . . . E . . . . . . N .
. O . . S . M T . A T . . G . . . . . . . . . . S . . . . S A .
. P . R . . E . L O L . E A . . . . . . . . . . . I . . . E E .
. . R . . R N F O A . N P R . . . E S N I B E G A R O T S N L .
. U . . S . T L B . I R . O . . . Q . L I G H T I N G N . I C .
B . . . E . S O . H A Y . T . . . U H E A V Y . . . . . R L . .
. . . . . D R . C H C . . S V . . I . . . . . . . . . . E Y . .
H . . . . A O A S N . . . E . . . P R O T C U R T S N I W T . .
O . . . T . M C E . . . N . . . . M . . . C . . . . . . O E . .
R . C O   . . G R Y T T C I R T C E L E H . . . . . . . P F . .
S . R U . . R . . O I . . . . . . N . I . . . . . . . . . A . .
E Y . . T E . . . L L . . . . . . T P . . . . . . . . . . S . .
P . . . M T . . A . R O . . . . . S . . . . . . . . . . . . . .
L . . E T . I T . O . . C . . . . . . . . . . . . . . . . . . .
A . . . . A I N P . . . . . . . . . . . . . . . . . . . . . . .
Y . . . . O E A G . . . . . . . . . . . . . . . . . . . . . . .
. . . . N . V H . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . S U O D R A Z A H . . . .
. . . . . . . . . . . . . . . D U S T . . . . . . . . . . . . .
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SHEET METAL TERMS #1

```
L D H G R T P P M V K C Y K P R Y D R A U D G E W W Y T Z M U P
I W S X Z C K N K Z Y C Y A B S A M Q R F M X H Z J T Z A E H E
U Z B R Z W G N K P Q X T A Y Z J W M E A Y I Y T C K E Y N E M
K B L D U P N B V R C U R C U G X C Z P K E J A C S K O E J C E
H K T V I O O S Y O U F F R F P U A G T H A H K S M X A I Q P H
A U F B O P Z V O I O V P T V F M R C A L B R S F L C Q L C N H
N D S Y G R W M B L Y I U G V Y D I Y W Q T O B G G Z W G I P J
D F Z S H J A B D R S Y Q O H F E B Y S E I Q K P N Y M M V J R
S V E S T C U E C V D E G V J M A Z H Z F N W H A C I T G A Y M
E H O F R A R M K V Z K A Q A E N L I K Y S L O Z Q S R V F U P
A P O V M W N E S N A C L A H H R F Y M P N C G Z O X V A T R N
M M N L N D D D V J F K V J Y A Z W I N U I U L L S O I C U O A
E A A M E P F Q A E H I A B K G G W B X Q P G D P A E J T I Q O
R E H D F W I J X R A X N K S C G A I A J S E I P S T A T E S S
N S T T A M G A S T D U I R B P X M G J A R N W E S A A X Q V W
F O T T W I N U I R Y R Z C V N E N Z Q I N S Y Z Z L P U C I E
E H T W V S K O M O S H E I A Y H T E N I N S E M U P Z J M Y E
U T V C K D N V Z P S R D W K R D M G N O S H T G M M Y J N D F
G M I O H S G N I D L E W T O P S C G A I A T N A E E I W I N Q
O T O G N E O P N T Z L A F G D O M G H B G A F E K T V J B O K
Y I I I R V R U A H N B B G E P B W F X L I E Y F T E M D C B Y
E U P U U V J E O K I B J O P A O Z V H R V O Z N N A S Y M Y A
R S H J D H T G U V O I M E S B X I L T D P P X R S Q G A P M Z
J A F A I M I H V J L N R D O U B L E S E A M E R D E L G Z V R
M B P E X O M N Q F D F K L O W I R S X T H T R E D L O F R A B
K I U J N N R J G D D W I R E G A G E T B T X R Q E B J B X X M
C S S P K F U S W I T E L D W V G H E R A W K D T R B T L O O Q
F A H Y Y K Y G N I T E V I R I L R N P N I D C P C G O Z B T Z
W I L X K Z Y W O U X K A C O V N R G O E R U Z T M Q A H F P O
P E U J A F H H I A A E I W O Z J L H S O I F N R H H D G T G P
W C M F P A W Y M U Q Y U F Q I O H E E Y N J G X E R N E Z I E
Q P O P R I V E T T M I J O H M D C G Z A G S F P A J P V E W M
```

THERE ARE 27 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

AVIATIONSNIPS
BARFOLDER
DOUBLESEAM
HANDSEAMER
MALLET
NOTCHER
PATTERN
RIVETING
SOLDERINGCOPPER
SPOTWELDING
STAKES
TINSNIPS
USSTANDARD
WIRING

BARFOLDER
BRAKE
GALVANIZED
HEM
NIBBLER
PATTERN
POPRIVET
SEAM
SPINNING
SQUARINGSHEAR
TEMPLATE
TRIANGULATION
WIREGAGE

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME:______________________________

SHEET METAL TERMS #1

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . B . . . . R . . . . . . . . . . . .
. . . . . . . . . . . . . A . . . . . E A . . . . . . . . . . M
. . . . . . . . . . . . R . . . . . . . K E . . . . . . . . . E
H . . . . . . . . . . F . . . . . . . . . A H . . . . . . . . H
A U . . . . . . . . O . . . . . . . . . . . R S . . . . . . . .
N . S . . . . . . L . . . . . . . . . . . T . B G . . . . . . .
D . . S . . . . D . . . . . . . . . . . . I . . . N . . . . . .
S . . . T . . E . . . . G . . . . . . . . N . . . . I . . . . .
E . . . . A R . . . . . A . . . . . . . . S . . . . S R . . . .
A . . . . . N . . . . . L A . . . . . . . N . . . O . . A . . N
M M . . . . . D . . . . V . . . . . . . . I . . L S . . . U O .
E A . . . . . . A . . I A . . . . . . . . P . D P . E . . I Q .
R E . . . . . . . R A . N . . . . . . . . S E I . . T . T . . S
N S . . . . . . . T D . I . . . . . . . . R N . . . A A . . . .
. O . . . . . . I . . . Z . . . . . . . I N . . . . L . . . . .
. . T . . . . O . . . . E . . . . . . N I . S . . U P . . . . .
. . . C . . N . . . . R D . . . . . G N . . . T G . M . . . . .
. . . . H S G N I D L E W T O P S C G . . . . N A . E . . . . .
. . . . N E . . . . . L . . . . O . . . . . A . . K T . . . . .
. . . I . . R . . . . B . . . P . . . . . I . . . . E . . . . .
. . P . . . . . . . . B . . P . . . . . R . . . . N . S . M . .
. S . . . . . . . . . I . E . . . . . T . . P . R . . . A . . .
. . . . . . . . . . . N R D O U B L E S E A M E . . . L . . . .
. . . . . . . . . . . . . . . . . . . . T . T R E D L O F R A B
. . . . . . . . . . . W I R E G A G E T . T . . . E . . . . . .
. . . . . . . . . . . . . . . . . . E . A W . . T . . . . . . .
. . . . . . . G N I T E V I R . . R . P . I . . . . . . . . . .
. . . . . . . . . . . . . . . . N . . . . R . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . I . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . N . . . . . . . . . .
. P O P R I V E T . . . . . . . . . . . . G . . . . . . . . . .
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SHEET METAL TERMS #2

```
Q H O P L D G B U O J R K X O P E R F R U F C M A E S C U E W W
H H Q Q O T K U R E L B B I N V G E N U F K P E W M U N S C T Z
N H H N D K S L P O R F P R P D L I O F W Z I G H H Z A A I K S
S N D A E N E B Z Y W B R O J A H T F B U O G Z W F V V Q M L B
W M J W M T E L L A M N V X D R S Q R A U Y M X I N Q X I I V Y
J H I O B H Q R N G W Y N D V F U L G U Y J G U W M E R Z O S O
O C H I Q J I Y F R P I S E H B E C M N R E T T A P D B U N O W
C S Q R Y X X G R S F F M C H F G A G K J A R K V P L F R M A E
Y F E T V H L Y F H P J G R V N N O I T A L U G N A I R T R A N
J X N G M U L B X W B I B Q I Q O Q Y K V U X F Z R E M U F X I
C U T L A B D R R K P A N N H J U Z C Q R H A U V O E F X O X S
W R G T L X U P M A L W N S Y L S A R F K H Q U F M Z T U L T S
P X Q T H Q S S T C W I W B N O J N K T N N Z Y H W I E T P E E
J W G B H W B Q A E P O M R A O T D K E V Z V E P L R I F A E R
D L U O F D C M U S G P J J U H I R E M A E S D N A H X T Q P T
E J U B L O L L K A C F Y T S P O T W E L D I N G S A K R D N L
Z E R S W G Y H V B R D H Q K K L R A B N K L B G W J Z X A N M
I J E A S V N M J E Q I E X Y J V M X I R E D L O F R A B N B A
N V P K G T E I R X C O N K O L G P C A V H Y B F L A O W Y N E
A R P H E M A P R O M C R G A T R N V W F A M F C F P D Y E Y S
V A O P M Y I N S I M I E M S R C A I T P K K T Z I O M E X E E
L L C S Y J U T D I W W D D Z H B Y S T P O P R I V E T S Y G L
A I G G I L A K O A O L L A N N E X H T E A R O B S G P P P A B
G Y N R X V A X V B R O O E V E M A E F Y V L P V D I Q S H G U
X R I C V A W Z P H X D F R Q P M M R Z N S I G M N O G C C E O
S M R J K Q L W X K F S R A X L P E O N L I P R S B A Y R B R D
Y H E W T J P Q A R S E A Z P L R Z A U B M B N C H L K S N I E
B J D N O T C H E R L V B R A R K P A H V B I I N J L J X C W V
Y G L M X S H C R R T K K T Z P Y B B O V T X H X Y R C E L P M
Z L O D Z P S T A K E S E A W X Y B K L H O Y C S V S Z C B X J
R M S B N K K X Z G J S Y S E Z X R I G W U E B J J K Y E L F T
X I Y J H A C K Q F I K W P R T O H Y B X L X F P C U D L Q B X
```

THERE ARE 27 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

AVIATIONSNIPS
BARFOLDER
DOUBLESEAM
HANDSEAMER
MALLET
NOTCHER
PATTERN
RIVETING
SOLDERINGCOPPER
SPOTWELDING
STAKES
TINSNIPS
USSTANDARD
WIRING

BARFOLDER
BRAKE
GALVANIZED
HEM
NIBBLER
PATTERN
POPRIVET
SEAM
SPINNING
SQUARINGSHEAR
TEMPLATE
TRIANGULATION
WIREGAGE

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME:________________________

SHEET METAL TERMS #2

```
. . . . . . . . . . . . . . . . . . . . . . . M A E S . . . . .
. . . . . . . . R E L B B I N . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . T E L L A M . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . N R E T T A P . . . . . .
. . . . . . . . . S . . . . . . G . . . . . . . . . . . . . . .
. . . . . . . . . . P . . . . N N O I T A L U G N A I R T . . .
. . . . . . . . . . . I . . I . . . . . . . . . . R . . . . . .
. . . . . . . . . . . . N N . . . . . . . . . . . . E . . . . .
. . . . . . . . . . . . N S . . . . . . . . . . . . . T . . . .
. . . . . . S . . . . I . . N . . . . . . . . . . . . . T . . .
. . . . . . . Q . . P . . . . O . . . . . . . . . . . . . A . .
D . . . . . . . U S . . . . . . I R E M A E S D N A H . . . P .
E . U . . . . . . A . . . . S P O T W E L D I N G . . . . . . .
Z . R S . G . . . . R . . . . . . . A . . . . . . . . . . . . M
I . E . S . N . . . . I E . . . . . . I R E D L O F R A B . . A
N . P . . T . I . . . . N K . . G . . . V . . . . . . . . . . E
A . P H E M A . R . . . R G A . . N . . . A . . . . . . . . . S
V . O . . . . N . I . . E . S R . . I . . . . . . . . . . . E E
L . C . . . . . D . W . D . . H B . . T P O P R I V E T S . G L
A . G . . . . . . A . . L . . . E . . T E . . . . . . P . . A B
G . N . . . . . . . R . O . . . . A E . . V . . . . I . . . G U
. . I . . . . . . . . D F . . . . M R . . . I . . N . . . . E O
. . R . . . . . . . . . R . . . P . . . . . . R S . . . . . R D
. . E . . . . . . . . . A . . L . . . . . . . N . . . . . . I .
. . D N O T C H E R . . B . A . . . . . . . I . . . . . . . W .
. . L . . . . . . . . . . T . . . . . . . T . . . . . . . . . .
. . O . . . S T A K E S E . . . . . . . . . . . . . . . . . . .
. . S . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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HEAT TREATING AND FORGING TERMS #1

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W P P J V H F C Y D G O S X U G Q B I B T P M B F K N S Q N U K
O E H R A H E Y N B H A V D Z W W D G D S Z H A Y F Y Q H N B C
F P J O Y V K O O G I J R K P X J U E N N V J G J T E M L Y X G
I H Y V P L B M X W R O R A H T A H O B S N E N A B G G C A W W
V X B M N U O H F I P Q R U C Z H I G N I L A E N N A R X I B D
Y I O W H H O D W F T E C D Y S S T R B P P L U B V U A A L T J
X F C K V H R V O Z S V J Z J U P P I S X L H Y T B C V C I R P
E L Z I J L W R W S G R N S R M Z S T M C Q D S I G E E P G N J
G R V B P Q G N K F F Z C T W V K D N M S S W W B M V L J U G T
P K E D B I S Y C X X R X V W N U V C R V K G V B I K V Q S W U
W A R F N J P X D M N E C Y W A B X T D D F C G A D H D G H J I
T P I G K S Y W S R R N F J U R A W S G F G N A F Q E W Z Y S V
P O V D Z Y Y D K G K C L K F Q D O C B E I I V L Y D Y G L R C
K N N L S A I T J N P T I C K J B Y H E Z G C U R B Z N Q R A I
V H M G W W I U D I W B V S A Q W V W I E S G Q W B O R U R N U
A J F F S S B S V H U Z N Y M L T I D L P L D H T R V H B D R M
B N G A O U L X G C O Z A C G H Y I K P E I A W M E B U U H Q Y
M D W T U I N L E N V L H G V G O H Y Q I R J A G A R C J Y U H
S L E D G E S K P E E Z E Z G R G E N Q D Q L N T I T M H L T I
T G N H U A I D I U F L A M E H A R D E N I N G Z I O K I X S R
I N O A L R V G C Q C U C H S Z E F N G Z X H I O Z O H M Q H F
N I B M C H X V N M V C P D K O T I Y I O A N N E S F K R C X E
E T R M Y G G S S I E S Q I N V N T N Z R G O E O J U M O D E B
S T A O N E R N T Y T W G B L G X G T D M A E B N O R T C E L E
A E C V G N I N E D R A H E S A C P Y M S C Q L E Y F V K K T E
K S A D T Q P R M G V D E D F N H H V V I F Y A S S D S W W S T
T P U E V N N G P E C A N R U F O H U G I J H W W H I L E I B K
B U P I V P L A E F A Q U T T L F O R G I N G M A U X M L L B L
A T X E F X G H R S W U O C E T K M L W K E P R G R A O L Q D F
S S M R T P A Z I D Y Z K T S X A B G U M Q W Y I U D Z P C T U
U R P A Z D R L N I P D J P V X B E X E P H X T N K Y M J E W J
C O N I N F O E G R L A S C R O I S H A W S Y C G D T H G D V Y
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THERE ARE 27 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ANNEALING
BLACKSMITH
CARBURIZING
DROPFORGING
EXTRUSION
FORGING
GRAIN
HARDYHOLE
INDUCTION
NORMALIZING
ROCKWELL
SPHEROIDIZING
TEMPERING
UPSETTING

ANVIL
CARBON
CASEHARDENING
ELECTRONBEAM
FLAMEHARDENING
FURNACE
HARDENING
HEATTREATING
KASENIT
QUENCHING
SLEDGES
SWAGING
TONGS

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME:______________________________

HEAT TREATING AND FORGING TERMS #1

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . D . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . R . . . . . . N . . . . . . . . . . . .
. . . . . . . . . . . O . . . . . . O . . . . . . . G . . . . .
. . . . . . . . . . P . . . . . H I G N I L A E N N A R . . . .
. . . . . . . . . F . . . . . . S T . . . . . . . . . . A . . .
. . . . . . . . O . . . . . . U . . I . . . . . . . . . . I . .
. . . . . . . R . . . . . . R . . . . M . . . . . . . . . . N .
. . . . . . G . . . . . . T . . . . . . S . . . . . . . . . . .
. . . . . I . . . . . . X . . . . . . . . K . . . . . . . . . .
. . . . N . . . . . . E . . . . . . . . . . C G . . . . . . . .
T . . G . . . . . . . . . . . . . . . . . . N A . . . . . . . .
. O . . . . . . . G . . L . . . . . . . . I . . L . . . . . . C
. . N . . . . . . N . . I . . . . . . . Z . . . . B . N . . A I
. . . G . . . . . I . . V . . . . . . I . . . . . . O . . R N .
. . . . S . . . . H . . N . . . . . D . . . . H . R . . B D . .
. . . . . . . . . C . . A . . . . I . . . . A . M . . U U . . .
. . . . . . . . . N . . . . . . O . . . . R . A . . R C . . . .
S L E D G E S . . E . . . . . R . . . . D . L . . I T . . . . .
T G N . . . . . . U F L A M E H A R D E N I N G Z I . . . . . .
I N O . . . . G . Q . . . H . . . . N . Z . H I O . . . . . . .
N I B . . . . . N . . . P . . . . I . I . A N N . . . . R . . .
E T R . . . . . . I . S . . . . N . N . R G . . . . . . O . . .
S T A . . . . . T . T . . . . G . G . D M A E B N O R T C E L E
A E C . G N I N E D R A H E S A C . Y . . . . . . . . . K . . .
K S . . . . . . M . . . E . . . . H . . . . . . S . . . W . . .
. P . . . . . . P E C A N R U F O . . . . . . . W . . . E . . .
. U . . . . . . E . . . . . T L F O R G I N G . A . . . L . . .
. . . . . . . . R . . . . . E T . . . . . . . . G . . . L . . .
. . . . . . . . I . . . . . . . A . . . . . . . I . . . . . . .
. . . . . . . . N . . . . . . . . E . . . . . . N . . . . . . .
. . . . . . . . G . . . . . . . . . H . . . . . G . . . . . . .
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HEAT TREATING AND FORGING TERMS #2

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A U R E U O W J A V E V T R M L J J G F H X N I B L Z E X U D Z
F I E J F S R S G V Y J J Z G E K O C N I V F X P U G B B U N D
W O I T I N E S A K D A C V N R G V R H M T Q C I A X S C R T E
G O Z F R D D T J E Q D E M I I W N A Z G V R H O U P X G M V G
N X J P O G J C K E B D J H N I D W O H M C V P Z H Q M X A J L
I C E B C F E O V V D Y B Z E U K A B R Y H R S E D A X N G L G
N S X W T A L S I A X K W S D P T V K V M E G R L E L N L L U X
E G T D V H F A A L H S I X R S L G X O I A O G B U E L E U S J
D W R L X V Q O M I V E T R A E Y T L L K I L N N A K W L N Q I
R K U X S I J J A E B E W A H T G J C D D D O I L T K N Q V A Y
A L S J Y L D F H L H X J X E T Q A G I X R C I Z C Z F O N U B
H H I R D L E Z A S L A O U S I L S Z Z T X N D O I D P T B Q J
N T O Q N M O E H D B U R U A N W I S C H G H R T W N Z R U B G
B D N H F F O D H S Y K X D C G N S E X N L L B C O C G E R C O
D B R X A G G C U Q X P B Q E G G L C H H S T U X G R N R Q M O
Q C C E S U G V X T Z D L K O N E A N Z L G K H Z F C D T B W J
N C W B K N R Y F V C A R B U R I Z I N G N P C O H A T C A W Q
H T R A I Y N U A J X C P O M W X N G G V O R E I G Z I Y L O C
V K J G C P O G H S C L W R P Z A U G N M T G N Z T A S T Y A C
G G A F U R N A C E W U C A O F Y S M W I O G Y E L Z K M T T J
A W N H F J E W N I A R G K M D O E K C T T B W O H Z N E N Y I
S N A I Y B W G J Z F H W J I Y E R O X T V A J M R A M Y S C I
K K O H G M O I U C K K K P D Y L Q G M G I T E B P P J F L V A
B R X B L R H Y F L S W U F P I O L L I Q K J J R E F B R E E P
X U A L R F O D Q M Y Q L P N L H G P J N G Z B R T S X P D Q U
L K L G F A D F D O B E W D S I Y K E L X G X I R F T V U G W O
K W N Q Y N C X O F X X U L A V D T X W P O N N U S D A Z E J C
W H T I M S K C A L B C G B R N R V O M R G J B T G N Z E S S D
C J R A F F P H J W T K S C K A A V X O X F J D A Z E I U H P C
O F J X T F C A S I Z I I X O I H D D X D J Z Q B T C Y T W E K
U R V K Y B G S O L N S T K V T U O Z Y B C K V A H T Y H V I J
J R C B E M K N W G J C N O X X H S T T M C S S R A D V W H D T
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THERE ARE 27 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ANNEALING
BLACKSMITH
CARBURIZING
DROPFORGING
EXTRUSION
FORGING
GRAIN
HARDYHOLE
INDUCTION
NORMALIZING
ROCKWELL
SPHEROIDIZING
TEMPERING
UPSETTING

ANVIL
CARBON
CASEHARDENING
ELECTRONBEAM
FLAMEHARDENING
FURNACE
HARDENING
HEATTREATING
KASENIT
QUENCHING
SLEDGES
SWAGING
TONGS

CIRCLE WORDS IN PUZZLE ABOVE:
WORDS MAY BE HORIZONTAL, VERTICAL,
DIAGONAL, FORWARD, OR BACKWARD.

NAME: ______________________________

HEAT TREATING AND FORGING TERMS #2

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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . G . . . . . . . . . . . . . . . . .
. . . T I N E S A K . . . . N . . . . . . . . . . . . S . . . .
G . . . . . . . . . . . . . I . . N . . . . . . . . P . . . . .
N . . . . . . . . . . . . . N . . . O . . . . . . H . M . A . .
I . E . . F . . . . . . . . E U . . . R . . . . E . A . N . L .
N . X . . . L . . . . . . . D P . . . . M . . R . E . N . L . .
E . T . . . . A . . . . . . R S . . . . . A O . B . E . E . . .
D . R . . . . . M . . . . . A E . . . . . I L N . A . W . . . .
R . U . . . . . . E . . . . H T . . . . D . O I L . K . . . . .
A . S . . . . . . . H . . . E T . . . I . R . I Z C . . . . . .
H . I . . . . . . . . A . . S I . . Z . T . N . O I . . . . Q .
. . O . . . . . . . . . R . A N . I . C . G . R . . N . . U . .
. . N . . . . . . . . . . D C G N . E . . . . . . . . G E . . .
. . . . . . . . . . . . . . E G . L . . . S . . . . . N . . . .
. . . . . . G . . . . D . . . N E . . . . G . . . . C . . . . .
. . . . . N . . . . C A R B U R I Z I N G N . . . H . . . . . .
. . . . I . . . . . . . . O . . . N G . . O . . I . . . . . . .
. . . G . . . . . . . . . . P . . . G N . T . N . . . . . . . .
. G A F U R N A C E . . . . . F . . . . I . G . . . . . . T . .
. W N . . . . . N I A R G . . . O . . . . T . . . . . . E . . .
S N . I . . . . . . . . . . . . E R . . . . A . . . . M . S . .
. . O . G . . . . . . . . . . . L . G . . . . E . . P . . L . .
. . . B . R . . . . . . . . . I O . . I . . . . R E . . . E . .
. . . . R . O . . . . . . . N L H . . . N . . . R T . . . D . .
. . . . . A . F . . . . . D . I Y . . . . G . I . . T . . G . .
. . . . . . C . . . . . U . . V D . . . . . N . . . . A . E . .
. H T I M S K C A L B C . . . N R . . . . G . . . . . . E S . .
. . . . . . . . . . T . . . . A A . . . . . . . . . . . . H . .
. . . . . . . . . I . . . . . . H . . . . . . . . . . . . . . .
. . . . . . . . O . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . N . . . . . . . . . . . . . . . . . . . . . . . .
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144

CASTING TERMS #1

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E D W U L A C M H Z F L G Y M E M G Q J P I A K W Q P L H N M I
G S W Y J C V V N Z X R Z J G E B O N E F V N Y H L N I R L W C
F D X G R X M E S F M Q E A Y A T T R M O L D Y L A M V Y O S E
E C Z Q X V N D X P C F H T G E O G E W Z R D E I G X U M O F B
M T D S G P F H D D C U Z G E O F T T A M W T D S Y W L Z O M K
G E T X F F R H Z Y S D R A G M H L T U X B J Z G V W L F S B T
C D R B C E N T R I F U G A L D O N A W A X B B N F P M Q P H H
C O R E M Y R H Z K W L T E T B E R P K H D H S O A K C L F J H
F J H M O S E R V I H Y L E H N A D Y U F F E O T R S A D O I Y
G W A U D Q Z I Z B M I J C A O J P O P B K P T D Y S D U U I C
K R U B Z A K D N L X P R M B F C L D Q G W E T B T T O K N L O
W O T D U J T A B M M Z R O I W V W T Q F R Z G E V G F A D E J
F K V Y J R S C F A I E M W B D W J D L N S M R C V G K A R U N
V D L O M L L E H S P Q L E J A O M E M F S M Z P U S A L Y O Z
L T S T S V T W D Y K M B R G M N W A V V O A A Y Z Q Z N V Q X
W O O X J W H V V B B S C K T N A K G D L A C N G K F K P W G R
Y A K M E U S C A L E U K C B C E L C D T Q G E D U G I S M N D
C H D X H W X L U G B M D H A R Z I V T U V L G A C G V K N D B
C T L Y U A D B N I I Q Y Y O U Q B F D M F G Y V T A E U F E T
V S R D O S S I V Q N O T L Y C S Y I S B O X X D E T S N T D R
E J Y Q R S T M Z W F V O A K I A F R K L K S A L C X G T X Q X
C O P E G S Z T H E B E E E G B O L E J I L W D G G N K R I A H
K X G U A R Q P Z F O G H S A L U U B P N H A R Y K A M H H N P
P H N C S K E K Y E W Q S N T E Q T R Z G L X A A D E U B O E G
V J E Q L W L E P F N Q B T Z M F U I I X O N B X J L Q Z X U R
D I S J A E U T N V Z Y S F M M E Q C C Q X U M Z C R W N P Z V
D Z D M G J X G V S C R F I V V J N K F W V E Y C C P V W S G B
O J K V E Z Q P D V A U V W M C X T T F A J W Q W L W H N N V Q
Y X U L M X R T G Q O N C A H H W F V R Q E K Q K Y Z I B Z G O
D C N D R T A Z P U Q B D C K K W A S B L C A Y G G K A Z F J N
L W B H A T I B K I Q I T R S B N G L K D Q W B Z M Q T M T F V
A U H V K O Z E B Z X C C W Q Y J H H U I L T C T D R B X A U Y
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THERE ARE 24 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

CENTRIFUGAL
CORE
DIECASTING
FIREBRICK
GREENSAND
LADLE
PATTERN
PERMANENT
PYROMETER
SANDCASTING
SHELLMOLD
TONGS

COPE
CRUCIBLE
DRAG
FOUNDRY
INVESTMENT
MOLD
PATTERNMAKER
PLASTERMOLD
RAMMER
SCALE
SLAG
TUMBLING

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME: ______________________________

CASTING TERMS #1

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . R . . . . . . N . . . . . . . . . . . . .
. . . . . . . . . . . . E . . . . . R M O L D . . . . . . . . .
. . . . . . . . . . . . . T . . . . E . . . . . . . . . . . . .
. . . . . . . . . . . . . . E . . . T . . . . . S . . . . . . .
. . . . . . R . . . . D R A G M . . T . . . . . G . . . . . . .
. . . . C E N T R I F U G A L . O N A . . . . . N . P . . P . .
C O R E M . . . . . . . . . . . E R P . . . . . O A . . L F . .
. . . M . . . . . . . . . . . N . . Y . . . . . T . . A . O . .
. . A . . . . . . . . . . . A . . . . P . . . T . . S . . U . .
. R . . . . . . . . . . . M . . . . . . . . E . . T . . . N . .
. . . . . . . . . . . . R . . . . . . . . R . . E . . . . D . .
. . . . . . . . . . . E . . . . . . . . N . . R . . . . . R . .
. D L O M L L E H S P . . . . . . . . M . S M . . . . . . Y . .
. . . . . . . . . . . . . . . . . . A . . O A . . . . . . . . .
. . . . . . . . . . . . . . . . . K . . L . . N . . . . . . . .
. . . . . . S C A L E . . . . C E . . D T . . . D . . . . . . .
. . . . . . . . . G . . . . . R . . . . U . . . . C . . . . . .
. . . . . . . . N I . . . . . U . . F . M . . . . . A . . . . .
. . . . . . . I . . N . . . . C . . I . B . . . . E . S . . . .
. . . . . . T . . . . V . . . I . . R . L . . . L . . . T . . .
C O P E G S . . . . . . E . . B . . E . I . . D . . . . . I . .
. . . . A R . . . . . . . S . L . . B . N . A . . . . . . . N .
. . . C S . E . . . . . . . T E . . R . G L . . . . . . . . . G
. . E . L . . E . . . . . . . M . . I . . . . . . . . . . . . .
. I . . A . . . N . . . . . . . E . C . . . . . . . . . . . . .
D . . . G . . . . S . . . . . . . N K . . . . . . . . . . . . .
. . . . . . . . . . A . . . . . . . T . . . . . . . . . . . . .
. . . . . . . . . . . N . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . D . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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CASTING TERMS #2

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Y E F G T W Y M B F I R E B R I C K L E D I T U O J G A F H D U
O W U I N M J U Y C X V L L A I D S V N G V C J W J C U I A Y D
F P B N S M P V M A Y H I K D C A N T M P T F J G T F S M H S C
U Q D J H L A D L E E H D M X P R R W O K V R V O W B N X H V B
B A K K X W X Z A R F S S T E G A X H C O L P Y Z R C Y A B I M
B K B Z W G Y D N T S T M E J F T M X H K S S C H X K I O K H H
A B G O C K C D U S H G L N E E P Z Y C E L X Q W D R E Y H N I
X U O Q C B P M V N I B M S P Q Z S R A G F K T L C L A H E P W
W I D A U C B L I I I D G S O K W A P D Q E D M X X J X F C X Y
Q B P L I L R F L C D N Q T A Y N T R U H I K R D J J W T M Q C
P L R R I F O J U W O I C J W W K P R L J R V I A G I R U J J H
E X C N E I H R D T T Q E E E T D L O M L L E H S M Y L C L W T
P T G K P T C K X I B G M C N B J C D C H R L I O G M P G K V I
O N T T O M E P G L C U B L A T R B R P M Z N O R D H E U B S E
C E S W J B Q M P K H D M Z P S R A A J V F J N J A Z U R F L B
K X M G T S M W O O V K I R B Q T I G N F A H H P Z V O H Z Y C
Z U F D S S O F T R B P W D G L S I F H E R X A W Y P R P B O P
T N E M T S E V N I Y I O B D B A M N U F A T K N J R D P P K J
J G F D F W E G E G E P T N H S N O N G G T Y Q K C L D A U O B
B S O L J A P E R M A N E N T F D L R F E A A F A O G B N M X X
T C H D H W A E E Y I V Y A P I C D P R T G L E M A S G J U A N
Z C J M Z O E E M I L A J U J K A N N Y E R X R L X N J X O O X
O H J X E N O O Z Y T I L C N N S Z P N E K E S W C P W F C V F
V I C N S H T Y U E S A R L T B T X F H D T A C Y R R N A E S Q
B H U A Y F D D T E O A S Q Z S I V S A S L G M H L X B K L W X
V F N P W Y H K D Z J C I C T G N E Y A L T X O N D N O B I W P
C D C U K C W F L K W X I U A M G S L R K B Y S X R C I N G N X
I O L O N L U V J R C R G M Z L B P P O F E O X L J E F E W X R
B J S X R I N J V F W M H X M Y E K Q K C Z Q H S R L T X B W E
F Z E X R E B G U U P L N L O G Y Q M A G S W L N P U M T F R B
Y W D M F U O U G V L W Z S K H G H V H J Q X R X I W F X A L N
B U P V Y V L F E N W U W S X R L S G Z M G H L C Z S A C O P Y
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THERE ARE 24 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

- CENTRIFUGAL
- CORE
- DIECASTING
- FIREBRICK
- GREENSAND
- LADLE
- PATTERN
- PERMANENT
- PYROMETER
- SANDCASTING
- SHELLMOLD
- TONGS
- COPE
- CRUCIBLE
- DRAG
- FOUNDRY
- INVESTMENT
- MOLD
- PATTERNMAKER
- PLASTERMOLD
- RAMMER
- SCALE
- SLAG
- TUMBLING

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL,
DIAGONAL, FORWARD, OR BACKWARD.

NAME:____________________________

CASTING TERMS #2

```
. . . . . . . . . F I R E B R I C K . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . L A D L E . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . T . . . E . . . . . . . . . . . . . . . . . .
. . . . . . . . U . . . L . . . . . . . . . . . . . . . . . . .
. . . . . . . M . . . B . S . . . . . . . . . . . . . . . . . .
. . . . . . B . . . I . G . . . . . . . . . . . . . . . . . . .
. . . . . L . . . C D N . . . . . . . . . . . R . . . . . . . .
. . . R I . . . U . O I C . . . . . . . . . . . A . . . . . . .
E . . N E . . R . T . . E E . . D L O M L L E H S M . . . . . .
P . G . . T C . . . . . . C N . . . D . . . . . . . M . . . . .
O . . . . . E . . . . . . . A T . . R . . . . . . . . E . . . .
C . . . . . . M . . . . . . . S R . A . . . . . . . . . R . . .
. . . . . . . . O . . . . . . . T I G . . . . . P . . . . . . .
. . . . . . . . . R . . . . . . S I F . . . . A . Y . . . . . .
T N E M T S E V N I Y . . . . . A M N U . . T . . . R D . . . .
. . . . . . . . . G . P . . . . N O . G G T . . . . L D . . . .
. . . . . . P E R M A N E N T . D L . . E A . . . O G . N . . .
. . . . . . . E . . . . . . . . C D . R . . L . M A . . . U . .
. . . . . . E . . . . . . . . . A . N . E . . R L . . . . . O .
. . . . . N . . . . . . . . . . S . . . . K E S . . . . . . . F
. . . . S . . . . . . . . . . . T . . . . T A . . . . . . . . .
. . . A . . . . . . . . S . . . I . . . S . . M . . . . . . . .
. . N . . . . . . . . . . C . . N . . A . . . . N . . . . . . .
. D C . . . . . . . . . . . A . G . L . . . . . . R . . . . . .
. . . O . . . . . . . . . . . L . P . . . . . . . . E . . . . .
. . . . R . . . . . . . . . . . E . . . . . . . . . . T . . . .
. . . . . E . . . . . . . . . . . . . . . . . . . . . . T . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . A . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . P .
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WELDING TERMS #1

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P Q Y G Y O I H Z R M H E E H R O C G H Z N R S V S Y D B D X N
Y N C H B T N N C T P T A D L K J R X F A U N B L F U E H D L Q
U T Y R Z E K W Y U U O Y E H S B X D B H R H X R Q G T W L C X
A A N W D H X C D T H T N I V I E U Q J S R G Y V A X M F M E U
W N R Z W P Z O M L I U O R H N R L Q E O C I O Z V L X U H G F
O F N C R G E X C R Y B L G L E V F G B V Z P F N E F H T V C Y
D X R A P B J D A Z H H T U G R O Q C G U O V T B N A Z R U Q J
U E I F W I Z L K X D E D U Y T M U C Z O T T T H Z H V V K E U
H A Z D R Q O H P P S O L L Q G D S F E S G T E C F M K E I W B
V V G M I P Q V D W W A Q I Z A F U N P N U B J R V O S U Y X W
O O C O W Z J B Q D T P A U F S T E S I R L S K O U W R C I J E
Y F R H M Q I A T O R J G A H O L N K Z A Z A A T I V I V C Q L
V M C K I O G N R H T W U E H Y A I E K N I U D G Z N S R N W D
R K E N J P R G G T M N L R T C R A O R E R P C N M I T T C D A
F D A J F N P U I G K I O E N T G D O R R E L L I F X R O J V B
T H D U H U N I G R U Y C A S U E W Z Z R U P G T C T J S A T I
T O Q L O Q R X N M G A M U O K Z M A P O Y C L T I C F E V J L
W Y S V A P U C G G Y N V S K N A T T Y T B E T U F D Z F B T I
D G T X O R J Z U X H B W R P F W S U D J F D O C E U E W N Z T
R N Q O I A M Z O B A A T O F O B E A M P E R A G E O S I X S Y
E G S R B S E R S S Z B M M L F T T L J Z X L Q W X R O I U E R
T N E R R U C B E N O W P M B Q B W F E F N D K E H J I O O V Z
T G U D J W K M G P S U D B E W R R E R C S D P J P X B D N N Y
P V G T U F E W E L D I N G D R Y A R L K T I C A Z N A T F L N
Z G D K G T N D V L Y C O I T E U E R J D P R L X D P R V J G M
M J Z M A G N J U C D Z W R V V W Q G V W I C O S D N E C U D J
Z Z V L K N S S P X C J U X H S N G O O M E N C D S E S M X N T
H V G E Z I N E U T R A L H C U W W L I X S E G K E G S O U A G
Y E V N A Z C A R B U R I Z I N G B D N U O R G U T Y A O P V R
M I D A J A M D O D B X J C S E G Y W A M H L Q M W X X E S Q J
R U T S Z R U T Z P U Z B W O M C F W Q B T I G U R O F T P K W
E J B F J B K Y H B U T Q V E K W Q Q F O Q V V Y N L H T L A J
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THERE ARE 37 WORDS HERE - CAN
YOU FIND THEM?

AMPERAGE
ARGON
BEAD
BRAZING
CARBURIZING
CURRENT
DIRECTCURRENT
FILLERROD
FUSION
GOGGLES
HELIUM
INERTGAS
MIG
OXIDIZING
OXYGEN
REGULATOR
STRIKING
TIG
WELDING

ARC
BASEMETAL
BLOWPIPE
BUTTJOINT
CHIPPINGHAMMER
CUTTINGTORCH
ELECTRODE
FLUX
GLOVES
GROUND
HOSE
LAPJOINT
NEUTRAL
OXYACETYLENE
POLARITY
SPOTWELDING
TANKS
WELDABILITY

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME: ______________________________

WELDING TERMS #1

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . A . . . . . . . . . . .
. . . . . . . . . . . . Y . . S . X . . . R . . . . . . . . . .
. A . . . . . . . . . T . . . I E U . . . . G . . . . . . . . .
. . R . . . . . . . I . . . . N R L . . . . . O . . . . . . . .
O . . C . . . . . R . . . . . E . F G B . . . . N . . . . . . .
. X . . . . . . A . . . . . G R . . . G U . . . . . . . . . . .
. . I . . . . L . . . . . U . T . . . . O T . . H . . . . . . .
. . . D . . O . . . . . L . . G . . . E . G T . C . . . . . . .
. . . . I P . . . . . A . . . A . . N . N . . J R . . . . . . W
. . C . . Z . . . . T . . . . S T E . I . . . . O . . . . . . E
. . . H . . I . . O . . . . H . L N K . . . . . T I . . . . . L
. . . . I . . N R . . . . E . Y . I E . . . . . G . N . . . . D
. . . . . P . . G . . . L . T . R . . R . . . . N M . T . . . A
. . . . . . P . . . . I . E . T . D O R R E L L I F . . . . . B
. . . . . . . I . . U . C . S . . . . . . U . G T . . . . . . I
. . . . . . . . N M . A . . . . . . . . . . C . T . . . . . . L
. . . . . . . . . G Y . . S K N A T . . . . . T U F . . . . T I
. . . . D . . . . X H B . . P . . . . . . . . . C . U . . N . T
. . . . . A . . O . A A . . . O . E A M P E R A G E . S I . S Y
. . . . . . E . . S . . M . . . T . L . . . . . . . R O I . E .
T N E R R U C B E . . . . M . . . W . E . . . . E . J I . O V .
. . . . . . . M . . . . . . E . . . E . C . . P . P . . D . N .
. . . . . . E W E L D I N G . R . . . L . T I . A . . . . . L N
. . . . . T . . . . . . . . . . . . . . D P R L . . . . . . G .
. . . . A G . . . . . . . . . . . . . . W I . O . . N . . . . .
. . . L . N . . . . . . . . . . . . . O . E N . D . E . . . . .
. . . . . I N E U T R A L . . . . . L . . S . G . E G . . . . .
. . . . . Z C A R B U R I Z I N G B D N U O R G . . Y . . . . .
. . . . . A . . . . . . . . . . . . . . . H . . . . X . . . . .
. . . . . R . . . . . . . . . . . . . . . T I G . . O . . . . .
. . . . . B . . . . . . . . . . . . . . . . . . . . . . . . . .
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150

WELDING TERMS #2

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N K G X U M H Y E F K V Q D X L X U G X O Z V Z W B G P Y D W R
I O C C U M D E S S Z S W L E P Z Q P I L Y S J S B N J G L S Y
X G K Z P T D A E B S G N Q G V U P H A R F R U P T A Z N V K H
I N E R T G A S D N U O R G D F Q G U O Z E K M O D W A I A E Z
E S X U W X T V Q H I D N W F Q R H Y G S T B P T F F P Z L O V
S T R I K I N G A S L X H G B C B A E G S E P G W P Q O I M P R
M R P F B V W L U M C Q N M K A O K L M F M T U E B Q U D G B U
T G L E M U K F P K P I Z S B P S P M G I B L R L Y M J I W V G
T O C X I L F L T R F E U Z B W N E O G H P Z R D O B E X T I O
K T D J M A L H Q M E O R O B D Y M M L F E A T I V L T O T C K
L Z B T Q V L V X O O M X A W Z Y B P E J N S T N H O B N U E X
E R F M N A T K L F X Q O B G B R P C E T S J A G Y W Q T O U A
V Z U W I I I U P M B K M R F E Z E W S L A E B Q K P T T L R N
K O B Z W D O A D Z J T M B E I C B L U G E L V P J I W F R Y I
Y M Z T Y N P J N W P N P E G U Z O B X R X C W O N P S K N A T
V O Q G W N P G T B E G N I Z I R U B R A C Q T G L E R B Q K H
N C B O I P R K R T Z L F N K U G H F N O O G T R N G L D G L X
X O D O B S A M Q E U L D O Y D T H E X C N O Y R O R G T W Y W
D R G B E F P F U J M B D A I D G U Y L I R V E S D D Z Y P J T
O W B R D E A T C L O M X B B R X G K Z C W G E Q X Y E G O D X
R E O I A G N Y N M M Y A M V I E V A H J U L Q L F F W L P I I
R F N W E C C E R E Y N Q H L N L R F V L G H T L A T L O L Y P
E I H D V G O U L P R D Z N G T B I L A G E C A M R A E R T F J
L Q Y B R J E T R Y H R U B W N T Z T O E P R E F C U Q I F P Q
L Z Z H M P N Z U R T V U H V D I O G Y S T G Q G O E R T G I I
I N D Q V I F P I D E E A C O K R P J Y U F T F L N A J I R R R
F T C O O B G K F T Y N C R T B G G P E X R F S I L I R T V X M
X I L J Q A G H K R U N T A S C H Q N I C V F D O M B D D P M E
O Y P B Y G Q C K H E G B F Y Z E V L B H Z G P C J U E L H W M
D A H I P V Y L P C S P Z W L X U R N X E C I S P B F C R E R F
L X A T E Y H D F E C Q B W E E O Q I X A J N D N H U L G Y W H
O V S J X P K L K I G P W L U P W X Z D L C R B Z R Q P V E Z A
```

THERE ARE 37 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

AMPERAGE
ARGON
BEAD
BRAZING
CARBURIZING
CURRENT
DIRECTCURRENT
FILLERROD
FUSION
GOGGLES
HELIUM
INERTGAS
MIG
OXIDIZING
OXYGEN
REGULATOR
STRIKING
TIG
WELDING

ARC
BASEMETAL
BLOWPIPE
BUTTJOINT
CHIPPINGHAMMER
CUTTINGTORCH
ELECTRODE
FLUX
GLOVES
GROUND
HOSE
LAPJOINT
NEUTRAL
OXYACETYLENE
POLARITY
SPOTWELDING
TANKS
WELDABILITY

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME:____________________________

WELDING TERMS #2

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. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . S . . . G . . .
. . . . . . D A E B . . N . . . . . H . . . . . P . . . N . . H
I N E R T G A S D N U O R G . . . . . O . . . . O . . . I . E .
. . . . . . . . . . I . . . . . . . . . S . . . T . . . Z L . .
S T R I K I N G A S . . . . B . . . . . . E . . W . . . I . . .
. . . . . . . . U M . . . . . A . . . . . M . . E . . U D . . .
. . . . . . . F . . P . . . . . S . . . I . . . L . M . I . . G
. . . . . . . . . . . E . . . . . E . G . . . . D . B . X . I .
. . . . . . . . . . . . R . . . . . M . . . . . I . L . O T C .
. . . T . . . . . . . . . A . . . . . E . . . . N . O . . U . X
. . . . N . . . . . . . . . G . . . . E T S . . G . W . T . U .
. . . . . I . . . . . . . . . E . . . . L A E . . . P T . L . .
. . . . . . O . . . . . . . . . . . . . . E L V . . I . F . . .
. . . . . . . J . W . . . . . . . . . . . . C . O N P S K N A T
. . . . . . . . T . E G N I Z I R U B R A C . T G L E . . . . .
N . . . . . . . R T . L . . . . . . . . O . G T R . G . . . . .
. O . . . . . . . E U . D . . . . . . X . N O . R O . . . . . .
D . G . . . . . . . M B . A . . . . Y . I R . E S . D . . . . .
O . . R . E . T . . . M . . B . . G . Z C . G E . . . E . . . .
R . . . A . N . N . . . A . . I E . A H . U L . . . . . . . . .
R . . . . . C E . E . . . H . N L R . . L G . . L A . . . . Y .
E . . . . . . U L . R . . . G . B I . A G . . A . R . . . T . .
L . . . . . . T R Y . R . . . N . . T O . . R . . C . . I . . .
L . . . . . N . . R T . U . . . I O G Y . T . . G . . R . . . .
I . . . . I . . . . E E . C . . R P . . U . . . . N A . . . . .
F . . . O . . . . . N C . T . . . P E . . . . . . L I . . . . .
. . . J . . . . . . . . T A . C . . N I . . . . O . . D . . . .
. . P . . . . . . . . . . . Y . E . . . H . . P . . . . L . . .
. A . . . . . . . . . . . . . X . R . . . C . . . . . . . E . .
L . . . . . . . . . . . . . . . O . I . . . . . . . . . . . W .
. . . . . . . . . . . . . . . . . . . D . . . . . . . . . . . .
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MACHINING TERMS #1

```
T S E R Y D A E T S C L C Y N E T K P S B Y D X O I V R D E F W
H R M P O C Z P S S T U B T I P C A O B G I G Z T Z G P R H C Z
N B J S Y J J E L N I N H D D V X X R X U Z R G G L F E I U H K
C B A W O C A Z F G T U A K Z Z U T W D R E T N E C S X L E H W
Z X H A D W F P O X Z O I C J Z Q O G B U F F I F D M O L B S U
F W W X J B D G K E Z Y F M I Q P A A B A L O R P E I B P H J S
L D I C L G K S C F K W P T X R L L I M D N E O D E E U R J Y K
I E J A P Y T E V G K F B D H V B K J U G Q O B T L K D E J M V
L K H Q I O N U K T Q O N I W R F U P Y J B O R I N G Y S Y A F
N F H U C I N R N P W A N T P I E H L X J C T E R D Q C S O A U
Z S D I U L F G N I T T U C T P M A L C P A R T S X U P C V V O
Q T Z V W R C T I V D E P R Y K G O D I Y P B N M H T Z W W V F
W B Z F I I R J W P Q P T E R A G N U I V Q A U O D E G F I S D
G S D H S E J Q K D V F W A E V S K I M N E L O Y E L D N I P S
O N K B S V M R F Y C C Q C L Q U D C X O G C C G N E Y Y F U L
H U I C G N I L L I M P U Z F P T E I O E W Z E A G R J L V P D
B I V P O X M M H U L A I D D A E R H T M D A W N F D U B A A K
B Y J V P T G R E U E A U U A B E C M D P P N S A T T I R L Y W
J V S P N A S X T W I S T D R I L L A O G O O I D E E A P A R W
M W K X B T T L M U Q Q E E L M W G W F R E J U S N L R D T A O
W K E M A M C N I T A P E R I N G E H P K Q G U N L A D E H D N
G A N G D R I L L A A K L L C Q R W A L W M M A E D M B E E I A
S H A P E R W Z N P T N L T P H G N I M A E R L I W R R P O U R
T N A L O O C Y S Q Y I G M A O P H E L T S S L T R S E S S S B
G N I D I V I D U D N K W C A C W L N U M T K A E V R Y S H T O
S I A R S Q N K Y G M W K W K Q B E E W S Z Q T L Y M A G T O R
E L O E G K U A O Z K S Y C W G Y Y R X X D M H L P X D C X O S
K K S Y H Q P F Z A A J P R F Z Q K D F K H F E O U U R I E L N
C I D C G C S F N W H O G E H K D B T W E W K D C L R U J W S Q
V P F T E C R G N R N K F W T N V N D F T E I O H L W M P O H P
Y U B Y M E V Q K Q Y C G N I L R U N K A Z D G U E U V X Z Z S
O K F R Y Z C X I U B V D B J X R B E Q H F X J H Y W B E B P T
```

THERE ARE 45 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

APRON
BANDSAW
CARRIAGE
COLLET
COOLANT
CUTTINGFLUIDS
DRILLPRESS
FACEPLATE
FLUTES
INDEXING
LATHE
LIVECENTER
MILLING
POWERFEED
PULLEY
REAMING
SPEED
STEADYREST
TAILSTOCK
TAPERING
THREADDIAL
TWISTDRILL
VISES

ARBORS
BORING
CENTER
COMPOUNDREST
COUNTERBORING
DIVIDING
ENDMILL
FEED
GANGDRILL
KNURLING
LATHEDOG
LUBRICANTS
PARALLELS
POWERHACKSAW
RADIUSTOOL
SHAPER
SPINDLE
STRAPCLAMP
TANG
TAPPING
THREADING
UPMILLING

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME:______________________________

BEST COPY AVAILABLE

MACHINING TERMS #1

```
T S E R Y D A E T S . . . . . . . . . . . . . . . . . . D . . .
. . . . . . . . . . T . . . . . . . . . . . . . . . . . R . . .
. . . . . . . . . . . N . . . . . . . . . . . G . . . . I . . .
. . . . . . . . . . . . A . . . . . . . R E T N E C . . L . . .
. . . . . . . . . . . . . C . . . . . . . . . I F . . . L . . .
. . . . . . . . . . . . . . I . . . . . . . . R . E . . P . . .
. . . . . . . . . . . . . T . R L L I M D N E O . . E . R . . .
. . . . . . . . . . . . . . H . B . . . . . . B . . . D E . . .
. . . . . . . . . . . . . . . R . U . . . B O R I N G . S . . .
. . . . . . . . . . . . . . . . E . L . . . . E . . . . S . . .
. S D I U L F G N I T T U C . P M A L C P A R T S . . . . . . .
. . . . . . . . . . . E . . . . G . D I . . . N . . . . . . . .
. . . . . . . . . . . . T . . . . N . I V . . U . . . . . . . .
G . . . . . . . . . . . . A . . . . I . N E . O . E L D N I P S
. N K . . . . . . . . . . . L . . . C X . G C C . . . . . F . .
. . I C G N I L L I M P U . . P . . . O E W . E . . . . L . P .
. . . P O . . . . . L A I D D A E R H T M D A . N . . U . A . .
. . . . P T . . . . . . . . . . . C . . P P N S . T T . R L . .
. . . . . A S . T W I S T D R I L L A O . O O I D E E A . A R .
. . . . . . T L . . . . . . . M . . W F R E . U S N L R D T A .
. . . . . . . . I T A P E R I N G E . P . . G . N L A . E H D .
G A N G D R I L L A A . . L . . R . A . . . . A E D . B E E I A
S H A P E R . . . . T N L . P H G N I M A E R L I . R . P . U R
T N A L O O C . . . . I G . A O . . . . . . S L T R . E S . S B
G N I D I V I D . . N . . C . . W . . . . . . A E . R . S . T O
. . . . S . . . . G . . K . . . . E . . . . . T L . . A . T O R
. . . E . . . . . . . S . . . . . . R . . . . H L P . . C . O S
. . S . . . . . . . A . . . . . . . . F . . . E O U . . . . L .
. I . . . . . . . W . . . . . . . . . . E . . D C L . . . . . .
V . . . . . . . . . . . . . . . . . . . . E . O . L . . . . . .
. . . . . . . . . . . . G N I L R U N K . . D G . E . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . Y . . . . . .
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MACHINING TERMS #2

```
H R P W D T L U N Y W C B U N W P N P J Y U E F L M Q L H Z C C
T A I L S T O C K W X J O R V U M N L U B R I C A N T S A L G Z
F B B N A G E A K R Q G J F V Z V M I Q U X U H O I S P T H C D
V W T X P T D G K H F V N T Y Z Q D T T D E W N T C T N A I G P
B R T D B S F N E L M C E I M O K H Z K N I C R U G E J Q J A Y
Q S O X H K M I M I I L O E P D A E C E L D C E J T A L U R N O
U M E A E G F L G I L S H M S P D M D B Q N T A K T D G Q Q G A
S H P U N E L L P O M Y D C P E A F T R W V H M A E Y U A F D D
B E H I E I O I C S R O B R A O S T X D N K R I S F R J N U R H
R A R D M O L M Q R J Y E K C T U I M Y D S E N T K E W C T I W
C O N D N Q Q J L L V Y R P D N N N V R I P A G K U S L K O L G
B E N D G I W Q N A S G Z U R B E A D P P E D M E W T M X I L I
Y E N Q S Y T K F C O M S N H C K I L R U E I P I H P H D N O A
I D S T N A R F W X C X N N G F J S D O E D N G G E L D N I P S
O L F M E J W Z A S L I V E C E N T E R O S G Y N C N R G R N U
R R O Z N R Y Y S Q P K H M Y T W P M T B C T E I E W N O L C N
P Y I M E Q D E X J Z I P B D T O E Y C U X P L R U A N Q P U Z
P O Q V P A R A L L E L S N W W I G F Q W L Z L O T F H F J T X
W E W C V P T F T F S T S I E P Q A F I G O F U B U T O K Z T A
O H E E L B N F Q Q H P S R M S Z I H W S R J P R J B B P Y I F
C S A L R O P O E R Y T F A X B B R P E T A L P E C A F G D N D
N N I S I H Q T E A D E L O T Z J R L F Z V Y E T N I N N I G D
U R W A X X A A V R E C R K E N B A J A A L U H N L S F I V F J
D M C Y R D D C I D P J Y I L M T C O G E N X G U N X G L I L C
H M U M W D T L K A G X E G P P W N L O N S Z G O E I Y L D U R
J M X X I M L X R S G N I L R U N K L D C N C N C O V I I I I N
U U L A R Z U T V R A D I U S T O O L E X A P I U Y U E M N D U
X C L I G M S V H V J W A B F K T C P H Y A Y R G I J M P G S U
H I N D E X I N G P D W E R H L M Q Q T K S Q E X X C D U R I W
L L V B O F P W C F W V B F J W E E P A R S W P E D V R X J P W
V C B T J M L T A N F J A I F T N X T L X Z L A N L A T H E R R
R U Y A A D S H L A M Y K Y P J O Y S U W Q H T E P O W R S X Y
```

THERE ARE 45 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

APRON
BANDSAW
CARRIAGE
COLLET
COOLANT
CUTTINGFLUIDS
DRILLPRESS
FACEPLATE
FLUTES
INDEXING
LATHE
LIVECENTER
MILLING
POWERFEED
PULLEY
REAMING
SPEED
STEADYREST
TAILSTOCK
TAPERING
THREADDIAL
TWISTDRILL
VISES

ARBORS
BORING
CENTER
COMPOUNDREST
COUNTERBORING
DIVIDING
ENDMILL
FEED
GANGDRILL
KNURLING
LATHEDOG
LUBRICANTS
PARALLELS
POWERHACKSAW
RADIUSTOOL
SHAPER
SPINDLE
STRAPCLAMP
TANG
TAPPING
THREADING
UPMILLING

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME:____________________________

MACHINING TERMS #2

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
T A I L S T O C K . . . . . . . . . L U B R I C A N T S . . . .
. . . . . . . . . . . G . . . . . . . . . . . . . . S . . . . .
. . . . . . . G . . . . N T . . . . . . . . . . . . T . . . G .
. . . . . S . N . . . C E I . . . . . . . . . R . . E . . . A .
. . . . H . . I . . . L O . P . . . . . . . . E . . A . . . N .
. . . A . G F L . . L . . M S P . . . . . . T A . . D . . . G .
. . P . N E L L . O . . . . P E A . . . . . H M . . Y . . . D .
B E . I E I . I C S R O B R A O S T . . . . R I . . R . . . R .
R A R D M . . M . . . . . . . T U I . . . S E N . . E . . . I .
C O N D . . . . . . . . . . . . N N V . . P A G . . S . . . L .
B E N D . . . . . . . . . . . . . A D . . E D . . . T . . . L .
. E N . S . . . . . . . . . . . . . L R . E I . . . . . . . . A
. . . T . A . . . . . . . . . . . S . O E D N . G E L D N I P S
. . . . E . W . . S L I V E C E N T E R O S G Y N . . . G R . .
. . . . . R . . S . . . . . . . . P . T . C T E I . . N O . C .
P . . . . . . E . . . . . . . T O E . . U . . L R . A N . . U .
. O . . P A R A L L E L S . W W . G . . . L . L O T . . . . T .
. . W . . P . . . . . T . I E P . A . . . . F U B . . . . . T .
. . . E L . . . . . H . S R M . . I . . . . . P R . . . . . I .
. . . L R . . . . R . T F A . . . R . E T A L P E C A F G D N .
. . I . . H . . E . D E L . . . . R . . . . . . T . . . N I G .
. R . . . . A A . R E C . . . . . A . . . . . . N . . . I V F .
D . . . . . D C I D P . . . . . . C . G . . . . U . . . L I L .
. . . . . D . L K A . . . . . . . . . O . . . G O . . . L D U .
. . . . I . L . R S G N I L R U N K . D . . . N C . . . I I I .
. . . A . . . T . R A D I U S T O O L E . . . I . . . . M N D .
. . L . . . S . . . . W . . . . . . . H . . . R . . . . P G S .
. I N D E X I N G . . . . . . . . . . T . . . E . . . . U . . .
. . . . . . . . . . . . . . . . . . . A . . . P . . . . . . . .
. . . . . . . . . . . . . . . . . . . L . . . A . L A T H E . .
. . . . . . . . . . . . . . . . . . . . . . . T . . . . . . . .
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FINISHING TERMS #1

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V V E V F V C I O L T R F H M Q B S C F F T P H T E E A L G J X
E V Y T G K I J T D V S N R W H R B E A G V J I F Q P T Z A V X
E Q O G Y P N O I B J O Z X S E E R F I N I S H I N G T D O J A
Y T A K C W I W D I P P I N G L T Z X Q K C M D P S Y I T F Z L
J I C B F V C O V A B A F P K E Q S N U H B K Q E Z I I J N R M
M L F H F L Q G W F K B C O I C B S F L Z S W C Q P E K X S P P
R G T A I E N L D O E A Z K R T T P P T U J U E K E N P N F C H
E Z W Q N N J A K R W V M O S R L L N G O F O R N D H I D D W D
M V G F N R G J G F K T I M Y O V E J C D O G W B D H L W D S R
I J L J Z Y C S F W R G Q S J F K V U N K Q S P R E D I D T H F
R Q J D B Q C J F F Q E P L A O T R C B M I Q H F Y R R J M T Z
P M T D K P F B S U K O J K R R K J I W T M G N I H S I N R U B
Z O G V H T U N A C L E U F M M B G N I D N I R G V N U W Z C D
L L Q Z D F N Q V I E N F A F I Y A I Y S F V T N H N S B G O R
I S R M F X V S S C I A Y W Q N E P F N W S Q Z G R A Z N Q N M
O N G I R P K H O R F M H E Y G N I T R I C A C I D A I M W F I
K M N N O U I R Q L U E O J G S N D H M F O P R Q K V N G P D C
E G Y N I N U T N L V L G F I D Z Q B A H T P P G A A F M M E J
  S W D G Z S T D E O E P B E S Z G L G A O L U R N S I R F F L
D T P V Z Z I G G N S D N T K V F P U P W Z H G C P I Y Y O X V
Z E C S R D G D M F E J N T J T A U N A T T N G B O W Y L Y W G
F N I R E F Q P O X W I X D X I K Q O F M E F V P W K R A X U F
X C C T N T S K L N A H A S M V L A C Q U E R E D D E V B R C Z
Q I R F N S Q M U P A T T R J H V R Z N L W U K O E G L T V P G
O L K G I S L B I W Q R K V L M L R Z J L W X M F R B H F E F S
K U L N H V I V W A P O X D N M C J B N Y A Q B L C A O N I D H
Z I J O T T P R X N P H A L G C Z V G Y Y W V E H O P B L T L X
M F M Z L V T O F J Q E L E C T R O P L A T I N G A I I O S R F
L X O U I F V V U C C Y O J E H A B N S E U X O K T N T Q U Z Y
M K W T F W R I R E J C S N Q U H Z U H H A C O B G N F P R G B
T T I B G J C M H C E E M R Z H C S P U N G Y J X S A C J T I R
V A J M R I W I R K Z Z F B A I X H J H Q M F S S F Y Z P M F F
```

THERE ARE 25 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ABRASIVE
BUFFING
DIPPING
ELECTROPLATING
ENGRAVING
FILING
GRINDING
NITRICACID
POLISHING
PRIMER
SOLVENT
STENCIL
WIREBRUSH

ANODIZING
BURNISHING
ELECTROFORMING
ENAMELED
ETCHING
FINISHING
LACQUERED
PAINTED
POWDERCOAT
RUST
SPRAYING
THINNER

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME: ______________________________

FINISHING TERMS #1

```
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
E . . . . . . . . . . . . . . E . . F I N I S H I N G . . . . .
. T . . . . . . D I P P I N G L . . . . . . . . . . . . . . . .
. . C . . . . . . . . . . . . E . . . . . H . . . . . . . . . .
. . . H . . . . . . . . . . . C . . . . . . S . . . . . . . . .
R . . . I . . . . . E . . . . T . . . . . . . U . . . . . . . .
E . . . . N . . . . . V . . . R . . . . . . . . R . . . . . . .
M . . . . . G . . . . . I . . O . . . . . . . . . B . . . . . .
I . . . . . . . . . . . . S . F . . . . . . . . . . E . . . . .
R . . . . . . . . . . . P . A O . . . . . . . . . . . R . . . .
P . . . . . . B . . . O . . . R . . . . . . G N I H S I N R U B
. . . . . . U . . . L E . . . M B G N I D N I R G . . . W . . .
. . . . . F . . . I . N . . . I . A . . . . . . . . . . . G . .
. . . . F . . S S . . A . . . N . . . . . . . . . . . . N . . .
. . G I . . . H O . . M . . . G N I T R I C A C I D . I . . . .
. . N N . . I . . L . E . . . . . . . . . . . . . . V . . . . .
. G . . I N . . . . V L . . . D . . . . . . . . G A . . . . . .
  S . . G Z . . . . . E . . E . . . . . . . . . R N . . . . . .
. T . . . . I . . . . D N T . . . . . . . . . G . P I . . . . .
. E . . R . . D . . . . N T . . . . . . . . N . . O . Y . . . .
. N . . E . . . O . . I . . . . . . . . . E . . . W . . A . . .
. C . . N . . . . N A . . . . . L A C Q U E R E D D . . . R . .
. I . . N . . . . P A . . . . . . . . . . . . . . E . . . . P .
. L . . I . . . . . . . . . . . . . . . . . . . . R . . . . F S
. . . . H . . . . . . . . . . . . . . . . . . . . C . . . I . .
. . . . T . . . . . . . . . . . . . . . . . . . . O . . L T . .
. . . . . . . . . . . E L E C T R O P L A T I N G A . I . S . .
. . . . . . . . . . . . . . . . . . . . . . . . . T N . . U . .
. . . . . . . . . . . . . . . . . . . . . . . . . G . . . R . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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FINISHING TERMS #2

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C K Y E C A F N B W X I Z B Y D K X B X A A L E F D M M C D R U
D K P P H D V K Z J U V G Q M S B K U H B D H A V B V K E Y U V
U I H Q   M D Y E V Y N D A F P K V E C R G S I Z J T T G S S L
K Z G I G Y E X W R E S L E A X T Y E U A V O D W J N H K N T B
F Y W Q N Y X W M Y K S U U L R I B N G S J L Z S I Z U P A W H
X O H B I K K R D B G Z P R D E I O N P I M V I A X O G J G C M
I M U Q F N I G D N P I O I Y O M I F D V A E P M J R T D N I V
P W F F F Q D Z I B X V N X V I M A Q V E B N M V Y X M P T H L
W O I A U H Y Y V V P L B J Q R J G N T N X T E F O D E T N M I
Z H T R B T A O V J K E R Y O H D U B E J U Y G X E A D T L V B
T K H J E R G Y Z L K C O F N F Z F Q C U N D E R E U Q C A L I
L Z S V P B F B X V S E O W A J V L Q D Y A I X S W P D D N A J
D G R S E J R U B U L R Q Q N W P D X G H N C V C Q O I K S D X
I U D X R R F U I F T B H U P C J C Q Z B O A V H M J B K Q Y Y
I Z X L G S X X S C W R G T K U P D I G L D C B R Y J H G Z M H
Y Q D C V E A S E H K E R N J L P Y N I W I I D T V D M G H Z G
R Z M X Y G J L H P N W L R L A Y I M Y K Z R G G R T H N Q K N
L W Z A Y P E X J S G D Y R J V H W C N K I T O E C N H I X Q I
U D V X K S R Z R M B F N D M S S G R L S N I E X F L J H I Q T
N B X P E L Y C T D M F J Q I K E Z T M D G N F C Q L O S O H A
Z O V O X K Z P M S G E O N L G H H F B X N V Q G Y Y Q I O R L
P R I M E R T G B F P N R H N V I N M M R K D K G W B P L P G P
F O T I V Y A Z N H C U F I Y N J C W L A O J V S D N P O N H O
J O Z H A O O F G I B Z H N N T V D N J P N U Q J X Q D P R S R
K T K F Q R C R M N V S F E L E R F E D H E K E J U R H B T I T
Y S I Q W T R R I M I A R E J J D E C G X W G R Q G P C E E D C
V T E F J E E Z W N V D R F I L I N G B F Z N C N M J N A E F E
M H Y Y F L D Z I U X I N G F N P U V F Q H I Y H L C W L Y Y L
R N H D D P W F D B U K B I N E P V A D M R H W E I E U T K Y E
B Q K B D B O O W K L V N W R E I N J J Y V C I L U G L P G P H
V K Q J C B P V H M Y D D G O G N D M K E T T L S Z Q J V P L K
G K U U R R S W D H P P Q W N M G Z U S A P E J G V P A R M O E
```

THERE ARE 25 WORDS HERE - CAN
YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ABRASIVE
BUFFING
DIPPING
ELECTROPLATING
ENGRAVING
FILING
GRINDING
NITRICACID
POLISHING
PRIMER
SOLVENT
STENCIL
WIREBRUSH

ANODIZING
BURNISHING
ELECTROFORMING
ENAMELED
ETCHING
FINISHING
LACQUERED
PAINTED
POWDERCOAT
RUST
SPRAYING
THINNER

CIRCLE WORDS IN PUZZLE ABOVE:

WORDS MAY BE HORIZONTAL, VERTICAL, DIAGONAL, FORWARD, OR BACKWARD.

NAME:________________________

FINISHING TERMS #2

```
. . . . . . . . . . . . . . . . . . . . A . . . . . . . . D R .
. . . . . . . . . . . . . . . . . . . . B . . . . . . . E . U .
. . . . . . . . . . . . D . . . . . . . R . S . . . . T . . S .
. . . . G . . . . . . . . E . . . . . . A . O . . . N . . . T .
. . . . N . . . . . . . . . L . . . . G S . L . . I . . . . . .
. . . . I . . . . . G . . . . E . . N . I . V . A . . . . . . .
. . . . F . . . . N . . . . . . M I . . V . E P . . . . . . . .
. W . . F . . . I . . . . . . . M A . . E . N . . . . . . . . .
. . I . U . . Y . . . . . . . R . . N . . . T . . . . . . . . .
. . . R B . A . . . . . . . O . . . . E . . . . . . . . . . . .
. . . . E R . . . . . . . F . . . . . . . . D E R E U Q C A L .
. . . . P B . . . . . . O . . . . . . . . A I . . . . . . . . .
. . . S . . R . . . . R . . . . . . . . . N C . . . . . . . . .
. . . . . . . U . . T . . . . . . . . . . O A . . . . . . . . .
. . . . . . . . S C . . . . . . . . . G . D C . . . . . . . . .
. . . . . . . . E H . . . . . . . . N . . I I . . . . . G . . G
. . . . . . . L . . . . . . . . . I . . . Z R . . . . . N . . N
. . . . . . E . . . . . . . . . H . . . . I T . . . . . I . . I
. . . . . . . . . . . . . . . S . . . . . N I . . . . . H . . T
. . . . . . . . . . . . . . I . . . T . . G N . . . . . S . . A
. . . . . . . . . . . . . N . G . H . . . . . . . . . . I . . L
P R I M E R T G . . . . R . N . I . . . . . . . . . . . L . . P
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. . . . . . C . . N V S . E . . . . . . . . . . . . . . . T . T
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. . . . . . W F . . . . . I N . P . . . . . H . . I . . . . . E
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APPENDIX 3

SAFETY AND MACHINE PICTURES

SAFETY INSTRUCTIONS COMMON TO ALL SHOP/LAB AREAS

Almost all accidents that occur in vocational education and industrial arts labs and shops are attributable to one of the causes listed below:

1. Taking unnecessary chances
2. Getting in too big a hurry
3. Showing off
4. Lack of information
5. Preoccupation
6. Distraction of attention
7. Fear
8. Experimenting
9. Failure to follow instructions
10. Poor discipline
11. Defective machinery
12. Improperly guarded machinery
13. Faulty layout
14. Faulty installation
15. Physical defects in material on machine parts
16. Excitement
17. Selfishness
18. Improper clothing
19. Poor health

Note that approximately 20 percent of all accidents are caused by mechanical failure (unsafe conditions), whereas approximately 80 percent of all accidents are caused by human failure (unsafe acts).

The safety regulations that follow offer specific, tangible suggestions for avoiding these common pitfalls and reducing the chance of accident and/or injury.

It is suggested that these safety instructions be used as examples in writing instruction sheets for each school situation, or that these safety instruction sheets be copied directly and used in the instructional program.

General Safety Instructions

1. No horseplaying or practical joking in any shop area.
2. Never take chances.
3. Observe all posted safety notices and posters.
4. Know where fire extinguishers are located and how to use them.
5. Ensure that the ventilation system is operating for your work station or area.
6. Secure approval of your instructor on all work you plan to do. This applies to all projects and assignments in which you use shop equipment and tools.
7. Report immediately to your instructor upon incurring any injury, even though slight.
8. Caution any person you see violating a safety rule.
9. Report to the instructor any equipment that does not seem to work properly.
10. Keep tools and materials from projecting over the edge of benches, whenever possible, so someone will not walk into them and get injured.
11. Follow prescribed safety instructions in handling large, heavy, and long pieces of material. In general, never carry material over six feet in length or over 50 pounds in weight without assistance.
12. Practice designated procedures to use in case of earthquake, fire, or other emergency.
13. Walk, do not run, in all shop areas.
14. Be considerate of the safety of others.

15. Adhere to safety rules pertinent to a specific shop.

16. Report unsafe conditions to the instructor.

17. Never throw any object in the shop; an accident or an injury may result.

18. Never use compressed air for other than specific purposes.

19. Make certain hands and tools are free of oil and grease.

20. Clean work stations and place tools in the proper areas at the end of each class period.

21. Study fire regulations pertinent to the shop so that you can assist in closing windows, making proper exits, etc.

22. If you feel ill, do not operate a machine. Report to your instructor.

23. Use proper lifting techniques when moving heavy objects.

24. Never treat or remove particles from the eye. See your instructor or school health personnel for immediate attention.

Safety Instructions for Personal Protection

1. Wear proper eye protection while participating in activities that may endanger your eyes.

2. Be sure clothes are safe and suitable for shop work. Remove or fasten any loose clothing. Roll loose sleeves above your elbows. Keep hair away from equipment in operation. Students with long hair must confine their hair in nets or caps when around tools and equipment.

3. Remove rings, bracelets, watches, and other jewelry when working in labs/shops.

4. Wear gloves when materials such as rough boards or metal which are subject to burrs or sharp edges, glass, or other such materials are handled.

5. Wear protective clothing and equipment for the use for which it is intended. Avoid wearing gloves or anything else that may be pulled into a machine.

6. Wear a respirator when harmful dust or fumes exist.

7. Use face shields during hazadous operations in cutting metal, wood, or similar material.

8. Never use flammable liquids for cleaning purposes.

9. Wear rubberized protective equipment when working with electricity.

10. Wear ear protection when excessive noise is encountered.

11. Wear helmets and hand shields when performing operations that produce intense radiant energy like arc welding and heavy gas cutting.

12. Wear canvas or heavy cotton work gloves for operations when the main hazards are blisters caused by friction. When heat is involved, as in foundry work, a more protective type of glove or mitten should be worn.

13. Wear safety shoes with steel toes when lifting heavy objects or working around them.

14. Wear shop coats, aprons, or coveralls for general body protection against dirt and grease.

15. Remove ties when working around machine tools or rotating equipment.

16. Use soap and water frequently as a method of preventing skin disease.

Safety Instructions for Use of Equipment and Tools

1. Use the right tool for the job.
2. Never leave a machine while it is running.
3. Observe rules governing operators' zones around tools and machines.
4. Use a brush or piece of wood to clear away dry chips from your machine or bench. (The machine must be turned off and must have come to a complete stop.)
5. Secure permission from your instructor for using machines and have special set-ups approved.
6. Do not use tools or equipment until you have received instruction relative to safe handling.
7. If you are not operating power tools or are observing the operation thereof, keep clear of operators.
8. Do not stop or start a machine for another person except in an emergency.
9. Operate machines one person at a time.
10. Do not use machines for trivial operations or when hand tools would best accomplish the task.
11. Do not tamper with adjustments or play with machinery at any time. Serious accidents may result.
12. Do not lean on machines. You may press a switch or throw a control which, upon starting, could endanger the safety of the operator or damage the machine.
13. Stop all power machinery to oil, adjust, or clean.
14. Allow revolving machinery to stop on its own. Resist the desire to grab chucks, spindles, or other rotating parts with the hand.
15. Use power tools only when your instructor is present in the room.
16. Set up shields to stop flying chips, sparks, or particles.
17. Replace grinding wheels showing cracks, those out of balance, or those worn too small to allow proper clearance (not more than 1/8") between the tool rest and stone.
18. Keep cutting tools sharp.

19. Never mount a grinding wheel unless the speed of the motor and the speed of the wheel are known and the two are appropriate.

20. When starting a machine, allow it to reach its operating rpm before using it.

21. When finished with a tool, clean and return it to its proper location.

22. Ensure that vise handles hang free when not in use.

23. Know and follow the specific requirements of the kind of machine you are operating.

24. Enclose all gears, moving belts, and other power transmission devices. or erect barricades to prevent contact.

25. Operate equipment only after passing a test for safe operation for that machine.

26. Do not use defective tools, machines, or other equipment.

27. Do not remove guards and safety devices.

28. Observe specific safety zones designated by the instructor and become familiar with color codes.

29. Do not talk with other students while operating machines.

30. Observe safety rules posted at or near potentially hazardous machines.

31. Do not operate any machine until you have received proper instruction, and fully understand how to operate it.

32. Have your instructor check special machine setups.

33. Check machines and make all adjustments before turning on the power.

34. Make sure no one is in the way before turning on the power.

35. Be sure the guards are in place and function properly.

36. Start and stop your own machine and remain with it until it has come to a complete stop.

37. Never leave a running machine unattended.

38. Allow a safe distance between your hands and blades, cutters, or moving parts. Keep your fingers in such a position that there is no danger of their slipping into the cutter or moving parts.

39. Keep machines clear of tools, stock, and other items.

40. Keep the floor around the tools free of liquids, scraps, tools, and other material.

41. Give the machine your undivided attention when using it. Never look away for any reason.

42. Notify your instructor of any breakage or malfunction.

43. Allow all machines to come to a complete stop before removing work or making a new setup.

44. Use the proper size and type of hand tool for the specific task.

45. Make sure that all cutting tools are sharp and in good condition before using them.

46. Use the handles of edged or pointed tools, with sharp points or edges pointed away from you and others.

47. When using sharp-edged tools, be sure to direct their action away from yourself and your classmates.

48. Clamp small work on a bench, or secure it in a vise, when using gouge or wood chisel or driving screws.

49. Control chisels, gouges, and carving tools with one hand while the other supplies the power.

50. When chipping or cutting with a cold chisel, arrange your work so that classmates are protected from flying chips.

51. Pass tools to other persons with handles forward.

52. Carefully read instruction sheets before operating machines.

53. Avoid using wrenches that do not properly fit the nuts, bolts, or other objects.

54. Develop a respect for machine tools and understand their purpose.

55. Recognize the distinctive sound of a properly adjusted and smooth-running machine tool.

Shop Housekeeping Practices

1. Keep your work station clean and orderly.
2. Keep passageways clear to allow easy movement while working and to allow for a rapid exit in case of an emergency.
3. Keep the floor clear of scraps and litter.
4. Keep bench and cabinet drawers and locker doors closed to avoid hazards while walking.
5. Wipe up any liquids spilled on the floor immediately; then apply oil-absorbing compound to the area.
6. Avoid storing or placing objects overhead, except where adequate storage space is provided.
7. Provide a nonskid surface for floors.
8. Sweep daily and periodically clean all shop/lab work areas.
9. Put stock away promptly after using it.
10. Ventilate shops properly. Serious disorders can be caused by uncontrolled vapors, mists, gases, and fumes.
11. Keep shop areas neat and orderly in appearance at all times. Cluttered or dirty shops are good sites for accidents. Neat and orderly shops help eliminate unsafe working conditions.
12. Maintain proper light levels in shops and study areas. Sight is essential for safety. Keep windows, light bulbs, reflectors, and walls bright but without glare. Replace burned out bulbs at once.
13. Daily remove all sawdust, shavings, metal cuttings, and other waste materials.
14. Place all scrap stock in the designated containers.
15. Keep the classroom and.shop orderly and clean with all tools and materials in their proper place.
16. Do not throw anything on the floor. Put it in the trash can.
17. Keep all clean-up equipment in its proper place when not in use.

SHEET METAL SAFETY

1. Sheet metal can cause serious cuts. Handle it with care. Wear steel reinforced gloves when possible.
2. Treat every cut immediately, no matter how minor.
3. Remove all burrs from the metal sheet before attempting further work on it.
4. Use a brush to clean the work area. NEVER brush metal with your hands.
5. Use tools that are sharp.
6. Keep your hands clear of the blade on the squaring shears.
7. A serious and painful foot injury will result if your foot is under the foot pedal of the squaring shears when a cut is made.
8. Do not run your hands over the surface of sheet metal that has just been cut or drilled. Painful cuts can be inflicted by the burrs.
9. Get help when cutting large pieces of sheet metal. Keep your helper well clear of the shears when you are making the cut.
10. Keep your hands and fingers clear of the rotating parts on forming machines.
11. Place scrap pieces of sheet metal in the scrap box.
12. Do not use tools that are not in first-class condition--hammer heads loose on the handle, chisels with mushroomed heads, power tools with guards removed, etc.
13. Wear goggles when in the shop.

HEAT TREATING SAFETY

1. Heat treating involves metal heated to very high temperatures. Handle it with the appropriate tools.
2. Wear goggles and the proper protective clothing, i.e. gloves and apron, but never an apron that is greasy or oil soaked.
3. Never look at the flames in the furnace unless you are wearing tinted goggles.
4. Do not try to light the furnace until you have been instructed in its operation. If you are not sure how it should be done, ask for further instructions.
5. Be sure the area is properly ventilated.
6. DO NOT use potassium cyanide as a case-hardening medium.
7. Do not stand over the quenching bath when immersing work.

CASTING SAFETY

1. Never pour a casting unless you are wearing protective clothing and goggles.
2. Moisture and molten metal react violently. Under no condition should moist or wet metal be added to molten metal.
3. Place hot castings where they will not cause accidental burns or fires.
4. Keep the foundry area clean.
5. Be sure your safety clothing is in first-class condition.
6. Do not talk with anyone while pouring a casting.
7. Stand to one side of the mold as you pour, never directly in front of it. Steam is generated during the pouring operation and may scald you. Molted metal may spurt from the mold if it is too moist.
8. Clamp or weight down molds of large castings to prevent the mold from floating and permitting molten metal to escape from the mold at the parting line.

GENERAL SAFETY INSTRUCTIONS FOR OXYACETYLENE WELDING AND CUTTING

1. Operate only with your instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing, and confine long hair.
3. Close the cylinder valve and replace the protective cover before moving the cylinder.
4. Fasten cylinders with a chain or other suitable device as a protection against falling or rolling.
5. Inspect all hoses before using.
6. Make sure that all hoses are properly connected and that all connections are tight.
7. Report any leaking of the cylinders or the connections to the teacher immediately.
8. Make sure that you have ample ventilation while welding.
9. Keep all flammable material away from welding area.
10. When preparing to weld, release the regulator pressure screw first; then, open cylinder valves gradually.
11. Open the acetylene cylinder valve one and one-fourth turns or less. Keep the wrench in place so that the valve may be shut off quickly, if necessary.
12. Keep the acetylene pressure in the hose below 15 pounds per square inch.
13. Use a friction torch lighter to light the torch.
14. Close the acetylene valve first if the torch backfires.
15. Make certain the lighted torch always points away from yourself and others.
16. Keep the sparks and the flame away from the cylinders.
17. Close the cylinder valves when you have finished your welding job.
18. Quench the section of the metal that has been welded, or mark it with chalk, or soapstone the word "hot" on the metal, if it is necessary for you to leave your work.
19. Always use the proper eye protection, including the proper shade of lenses when welding and cutting, or safety glasses or goggles when chipping and grinding.

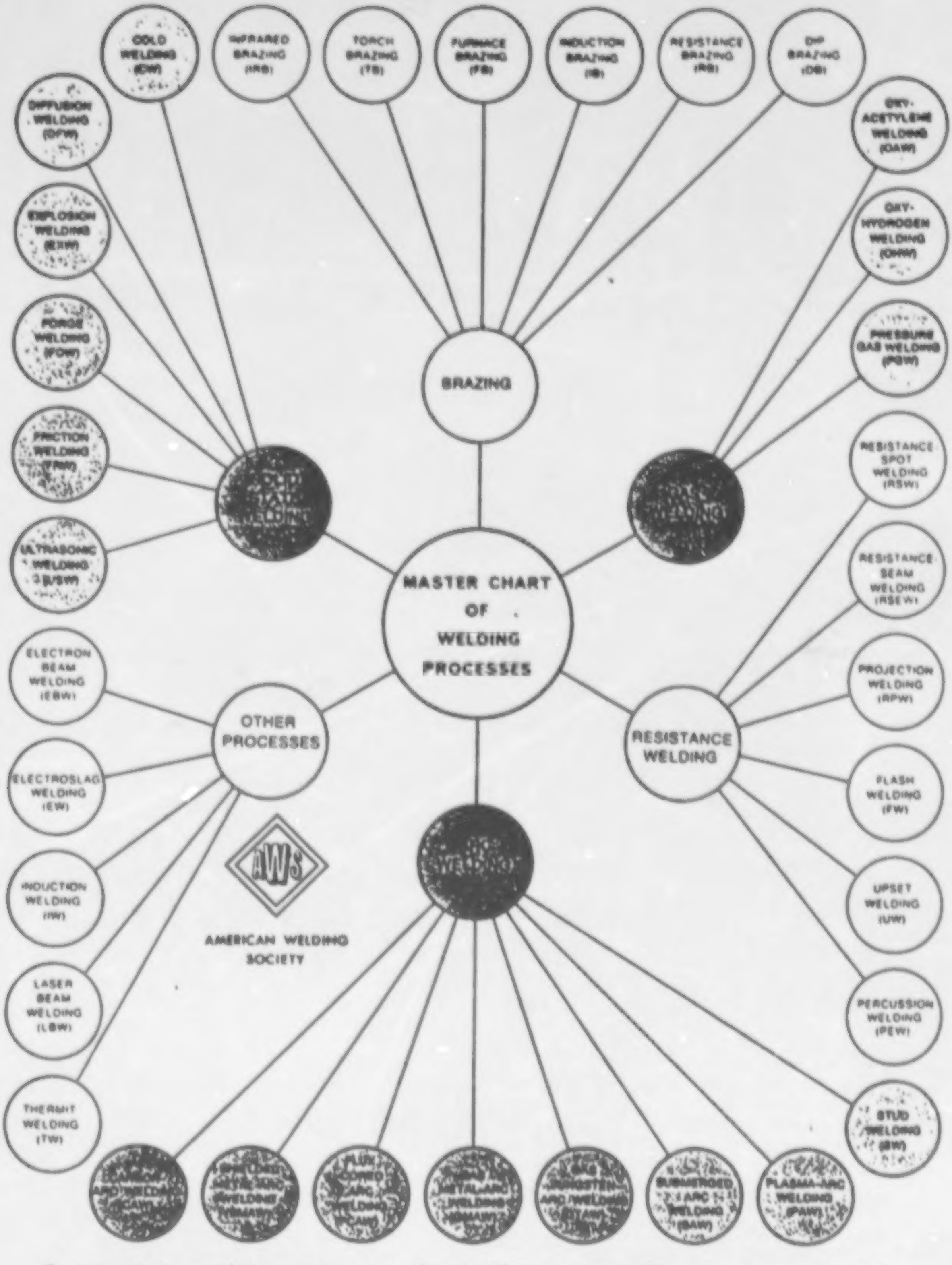
20. Do not allow oil to come in contact with hoses or equipment.

21 Keep the cylinder caps on the bottles when not in use.

22 Confine all cutting and welding to the designated area in the shop.

23. Do not weld galvanized metal without the proper ventilation.

24. Do not weld or cut on a closed container without your instructor's approval.


MASTER CHART OF WELDING PROCESSES
BRAZING
INFRARED BRAZING (IRB)
TORCH BRAZING (TB)
FURNACE BRAZING (FB)
INDUCTION BRAZING (IB)
RESISTANCE BRAZING (RB)
DIP BRAZING (DB)
COLD WELDING (CW)
DIFFUSION WELDING (DFW)
EXPLOSION WELDING (EXW)
FORGE WELDING (FOW)
FRICTION WELDING (FRW)
ULTRASONIC WELDING (USW)
OXY-ACETYLENE WELDING (OAW)
OXY-HYDROGEN WELDING (OHW)
PRESSURE GAS WELDING (PGW)
RESISTANCE WELDING
RESISTANCE SPOT WELDING (RSW)
RESISTANCE SEAM WELDING (RSEW)
PROJECTION WELDING (RPW)
FLASH WELDING (FW)
UPSET WELDING (UW)
PERCUSSION WELDING (PEW)
STUD WELDING (SW)
OTHER PROCESSES
ELECTRON BEAM WELDING (EBW)
ELECTROSLAG WELDING (EW)
INDUCTION WELDING (IW)
LASER BEAM WELDING (LBW)
THERMIT WELDING (TW)
FLUX CORED ARC WELDING (FCAW)
SUBMERGED ARC WELDING (SAW)
PLASMA-ARC WELDING (PAW)
AWS
AMERICAN WELDING SOCIETY

A complete welding process chart. (Courtesy of The American Welding Society.)

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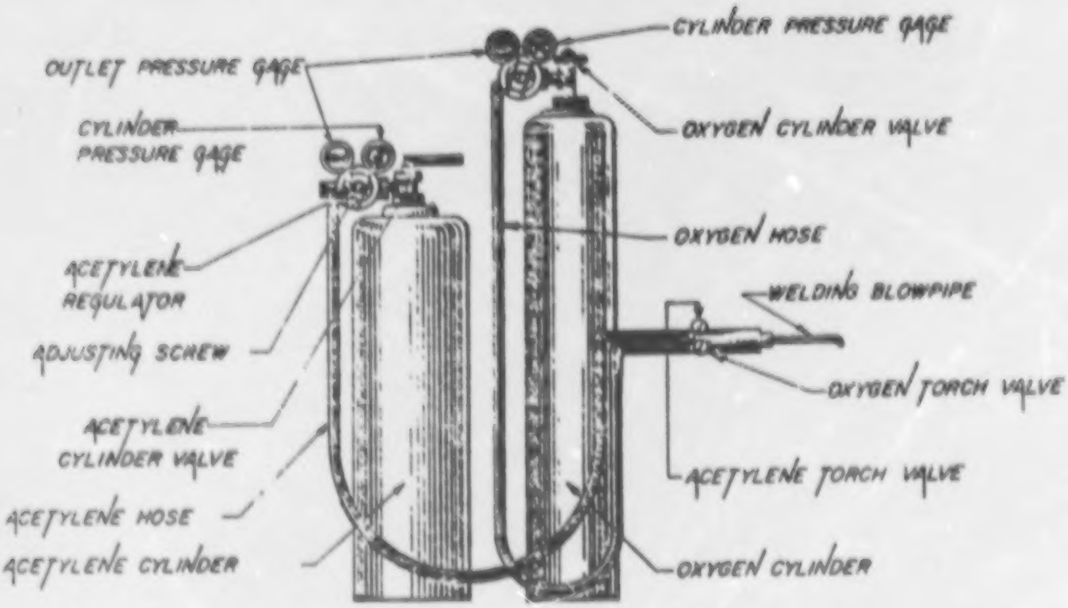
TRANSPARENCY MASTER


CYLINDER PRESSURE GAGE
OUTLET PRESSURE GAGE
CYLINDER PRESSURE GAGE
OXYGEN CYLINDER VALVE
OXYGEN HOSE
ACETYLENE REGULATOR
WELDING BLOWPIPE
ADJUSTING SCREW
OXYGEN TORCH VALVE
ACETYLENE CYLINDER VALVE
ACETYLENE TORCH VALVE
ACETYLENE HOSE
ACETYLENE CYLINDER
OXYGEN CYLINDER

OXY-ACETYLENE WELDING

GENERAL SAFETY INSTRUCTIONS FOR ELECTRIC ARC WELDING

1. Obtain permission from your instructor before using an electric welder.
2. Wear a hood with a proper observation window, treated gauntlet gloves, and treated leather apron. All assistants and observers must also wear this equipment.
3. Wear rubber soled shoes, without tracks, when electric welding.
4. When operating the electric welder, allow no one to look at the arc without the dark shield.
5. Make sure electric welding is done only in a correctly constructed booth or room, or behind proper screens.
6. Make sure there is ample ventilation while welding.
7. Keep all flammable material away from the work area.
8. See that the floor area is free of all obstructions.
9. Report to the instructor at once if the electrode holder, the holder cable connection, the cable terminals at the welding machine, the ground clamps, the lugs, or the cable get hot.
10. While removing the scale from the work, wear ordinary safety glasses or goggles.
11. Have a fire extinguisher handy when electric welding.
12. Hang up the electrode holder and turn off the welder when work is being changed or when work has been completed.
13. Keep your sleeves and pants' cuffs rolled down and your collar buttoned up.
14. Be sure that the tops of your shoes are covered while welding.
15. Keep the cable from contacting any hot metal.
16. Keep any electrode stubs off the floor. They could easily cause a slip or fall.
17. Avoid the inhalation of fumes while welding galvanized steel, phosphor bronze, and stainless steel.

SAFETY INSTRUCTIONS FOR OPERATING THE TIG AND MIG WELDERS

1. Operate only with your instructor's permission and after you have received instruction.

2. Remove jewelry, eliminate loose clothing, and confine long hair.

3. Wear additional protective welding clothing, including a helmet, a long-sleeved jacket, and gloves to prevent burns from ultraviolet and infrared rays emitted while arc welding.

4. Ensure that the helmet used for TIG or MIG welding is equipped with a minimum number 12 density shade.

5. Be certain that the welder equipped with a high frequency stabilizing unit is installed, maintained, and used according to the recommendations of both the manufacturer and the Federal Communications Commission.

6. Never touch the tungsten electrode or MIG wire while the welder is turned on. It is electrically "hot" and can cause a serious shock.

7. Never use the high frequency when performing shield metal arc (stick electrode) welding.

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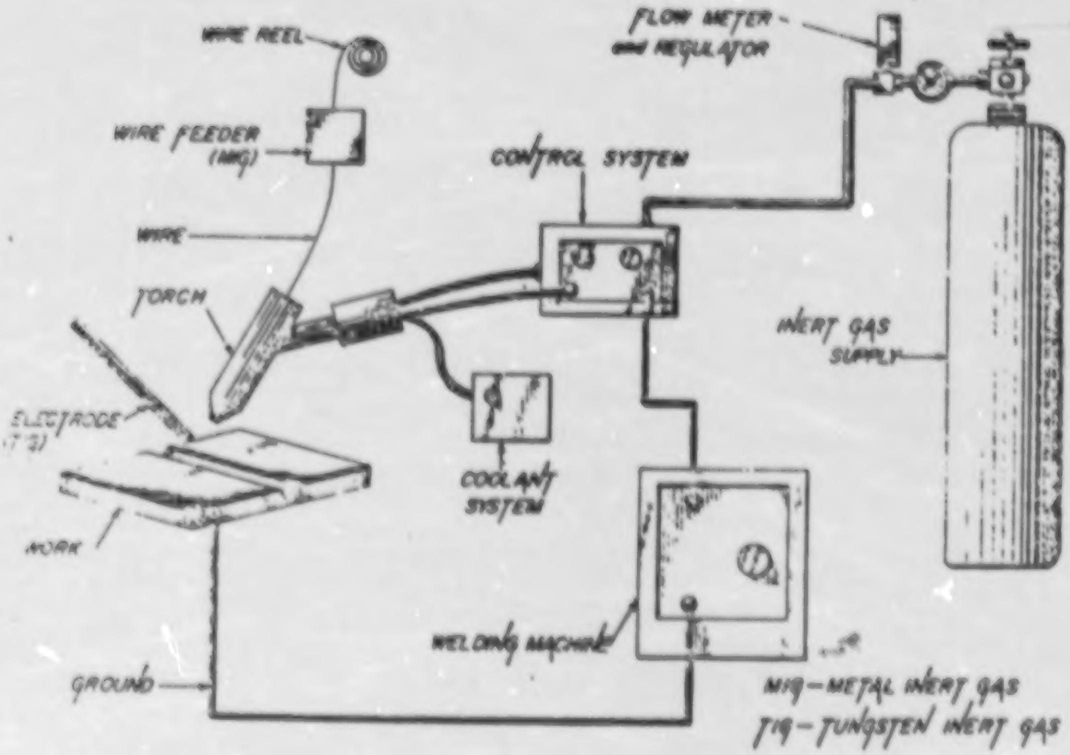

WIRE REEL
WIRE FEEDER (MIG)
WIRE
TORCH
ELECTRODE (TIG)
WORK
CONTROL SYSTEM
FLOW METER and REGULATOR
COOLANT SYSTEM
INERT GAS SUPPLY
WELDING MACHINE
GROUND
MIG—METAL INERT GAS
TIG—TUNGSTEN INERT GAS

TIG/MIG WELDING

Electrical Safety Instructions

1. Know where electrical circuit breakers are located for an emergency shutoff.
2. Keep electrical boxes closed.
3. Ground all portable and stationary power tools.
4. Keep hoses and electrical cords from becoming tripping hazards.
5. Do not use electric drills or any other electrical apparatus while standing on wet floors.
6. Cords are to be disconnected when portable tools are not in use.
7. Check for frayed electrical cords.
8. Disconnect electrical power equipment before oiling, cleaning, or making adjustments.
9. Do not use extension cords for permanent connections.
10. Ground all motors, fuse boxes, switch boxes, and other electrical equipment.
11. Assume that an electrical apparatus is "hot" and treat it as such.
12. Use a test lamp or a suitable meter for testing a circuit.
13. Never turn on a switch unless you know what it operates.
14. Turn off power when replacing a fuse.
15. Locate and correct the fault that caused the circuit breaker to open or the fuse to blow before turning on the power.
16. Be sure a circuit is protected against an overload by a fuse or circuit breaker of correct circuit-carrying capacity.
17. Make changes in the wiring of a circuit only when the power is turned off.
18. Select and use wire of the correct current-carrying capacity.

GENERAL SAFETY INSTRUCTIONS FOR THE MACHINE SHOP

1. Keep your work area free from scraps of metal stock.
2. Keep metal cutting tools sharp.
3. Always put a handle on a file before you use it.
4. Grind mushroom heads and all burrs off cold chisels, center punches, and other small hand tools.
5. Never try to hold a piece of metal in your hand while it is being machined. Use a fixture or a clamp to hold the workpiece.
6. Wear appropriate gloves when handling hot metals.
7. Always wear eye protection. A sliver of metal in the eye can cause blindness.
8. Put away tools and accessories. Clutter causes accidents.
9. Exercise caution when using portable hand tools, spot welders, electric shears, and the like. (These tools operate on at least 110 volts of electricity. This charge can either kill or cause a serious shock or burns under certain conditions.) Make sure that the power cords are in good working condition and that plugs are not broken. Keep cords away from oil and hot surfaces.
10. Be sure that your hands are dry before using an electrical power tool.
11. Never use measuring tools on metal while it is being machined.
12. Always keep machine guards in place. They were put there for your protection.
13. Operate a machine only after you have received instruction on its use. Remember that you must know what you are doing before you start a machine.
14. Stop a machine before oiling it.
15. Never "feel" the surface of a metal while it is being machined.
16. Clean chips off with a brush, never with a rag or your hand.
17. Never allow anyone to stand near a machine that you are operating.
18. Handle files carefully since they are brittle. They can shatter in your hands. Always use a file with a handle.

19. Wear protective clothing when working with hot metals.

20. Wear a face mask when there is a danger of flying chips.

21. Wear goggles when grinding metals.

22. Do not attempt to oil, clean, adjust, or repair any machine while it is running. Stop the machine and lock the breaker box in the "off" position.

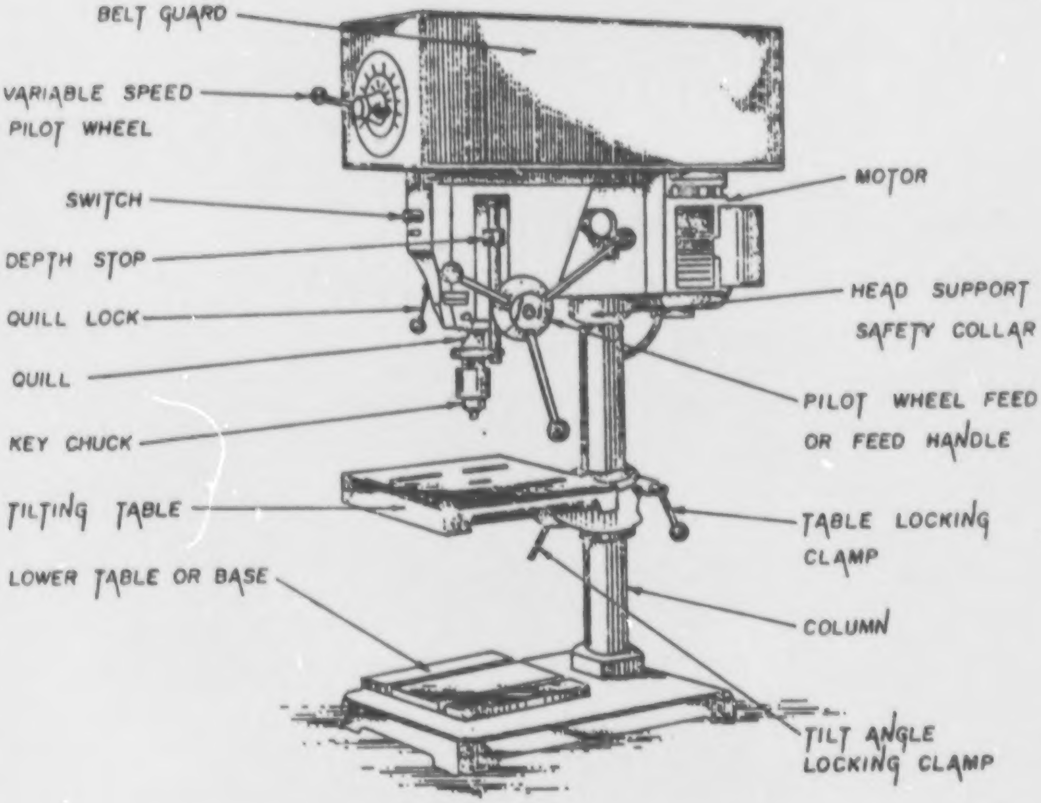
23. Get help for handling long or heavy pieces of material. Follow safe lifting practices, lifting with your legs, not your back.

24. Do not talk to others when they are operating machines.

SAFETY INSTRUCTIONS FOR OPERATING THE DRILL PRESS

1. Wear proper eye protection.
2. Hold material securely with a vise or clamps.
3. Select a properly sharpened bit. For metal, center punch when a hole is to be drilled.
4. Adjust the table or the depth stop to avoid drilling into the table.
5. Select the correct speed, normally slower for metal—faster for wood. The larger the bit, the slower the speed.
6. Be certain that the table and head of the drill press are secure.
7. Select the correct size and the kind of drill for the work. Be sure it is sharp.
8. Select the designated coolant for the drill press and apply it to the drill point as needed. (No coolant is used when drilling wood.)
9. See that the belt guard is in place.
10. Remove the chuck key immediately after using it.
11. Keep hands away from the revolving spindle, chuck, drill, and chips.
12. Operate the feed handle so that the drill cuts evenly into the work.
13. Ease up on the feed pressure when the drill begins to break through the material.
14. Back the drill out as soon as the hole is drilled.
15. Allow the drill press to stop before attempting to remove the work, chips, or cuttings. Do not stop the revolving chuck with your hands.
16. Use a brush to remove the chips or the shavings.
17. Keep the floor clean around the drill press.
18. Step away immediately if the work comes loose and is caught in the drill. Shut off the power, if possible, without endangering yourself.

TRANSPARENCY MASTER

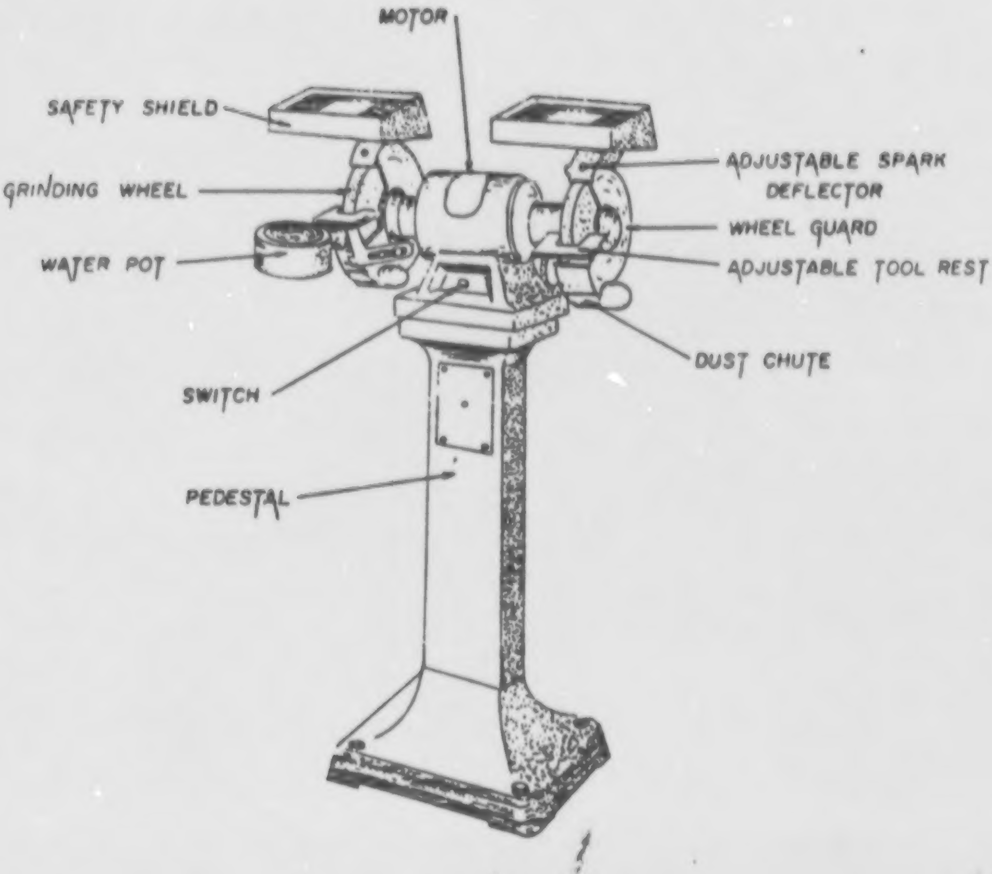

BELT GUARD
VARIABLE SPEED PILOT WHEEL
SWITCH
DEPTH STOP
QUILL LOCK
QUILL
KEY CHUCK
TILTING TABLE
LOWER TABLE OR BASE
MOTOR
HEAD SUPPORT SAFETY COLLAR
PILOT WHEEL FEED OR FEED HANDLE
TABLE LOCKING CLAMP
COLUMN
TILT ANGLE LOCKING CLAMP

DRILL PRESS

SAFETY INSTRUCTIONS FOR OPERATING THE GRINDER

1. Obtain permission from the instructor before operating a grinder.
2. Wear proper clothing.
3. Wear a face shield, safety glasses, or goggles and use a glass safety guard on a grinder.
4. See that the guard is in place.
5. Set tool rest 1/16" to 1/8" from the wheel.
6. Dress the wheel when necessary.
7. Make sure that no one except you is inside the operator's zone.
8. Adjust the grinder for your job before turning the power on.
9. Stand to one side of the wheel when turning the power on. The wheel may be cracked, causing it to break up.
10. Turn on the power after permission is given.
11. Keep your hands away from the wheel while it is in motion.
12. Hold the work with your hands. Ask permission to grind small pieces.
13. Use only the face of the wheel.
14. Press materials against the wheel with the correct amount of pressure.
15. Keep the work in motion across the face of the wheel.
16. Do not grind on the side of the grinding wheels.
17. Stand to one side when starting the machine.
18. Discard or report grinding wheels that are excessively small or cracked.
19. Hold small work pieces with a "vise grip" type of pliers.
20. Do not leave the machine until the grinding wheels have come to a complete stop.

TRANSPARENCY MASTER


MOTOR
SAFETY SHIELD
GRINDING WHEEL
WATER POT
ADJUSTABLE SPARK DEFLECTOR
WHEEL GUARD
ADJUSTABLE TOOL REST
DUST CHUTE
SWITCH
PEDESTAL

PEDESTAL GRINDER

SAFETY INSTRUCTIONS FOR OPERATING THE BUFFER

1. Obtain permission from your instructor before using the buffer.
2. Wear a face shield, safety glasses, or goggles.
3. Hold work with both hands.
4. Secure special instruction and permission from your instructor before buffing small pieces.
5. Make sure that no one except you is inside the operator's zone.
6. Turn on the power only after permission is given.
7. Apply the compound sparingly.
8. Keep your hands away from the wheel while it is in motion.
9. Hold the work below center (horizontal axis) as the wheel revolves toward you.
10. Buff the flat surfaces from the center toward the lower edge. Sharp edges should point downward.
11. Press the material against the wheel with the correct amount of pressure.
12. Turn off the power after using the buffer.
13. Clean the buffer and the area with a brush.

SAFETY INSTRUCTIONS FOR OPERATING THE MILLING MACHINE

1. Obtain permission from the instructor before using the milling machine.
2. Wear a face shield, safety glasses, or goggles.
3. Make adjustments or set up only when the machine is at a dead stop.
4. Use correct fitting wrenches on machine parts.
5. Handle all cutters carefully.
6. Use only a soft hammer or mallet to seat work against the parallels or the bottom of the vise.
7. Select the proper cutter. Be sure it is sharp.
8. Be sure the job is securely fastened.
9. Make certain that the work, milling machine table, and any holding device will clear the arbor and support during the cut.
10. Set the machine for the proper depth of cut.
11. Disengage handles when the automatic feed is to be used or the table is to be locked.
12. Select the correct feed.
13. Make sure that no one except you is inside the operator's zone.
14. Stand to one side of the machine.
15. Turn on the power after permission is given.
16. Be sure that the cutter is turning in the proper direction.
17. Feed against, or opposite to, the direction of the rotation of the cutter.
18. Use a brush to remove chips from work when the machine is at rest.
19. Keep the floor clean around the machine.
20. Turn off the power after using the milling machine and remain there until the machine has stopped.
21. Release all of the automatic feeds.
22. Clean the machine and the area with a brush.

23. Be sure the cutter is tightly held in the collet and the material is securely held by a vise, clamps, or magnetic chuck.

24. Check the spindle rotation, speed, depth of cut and all power feed adjustments before starting the cut.

25. Keep your hands away from the cutter. Remove the chips with a brush after the machine is turned off.

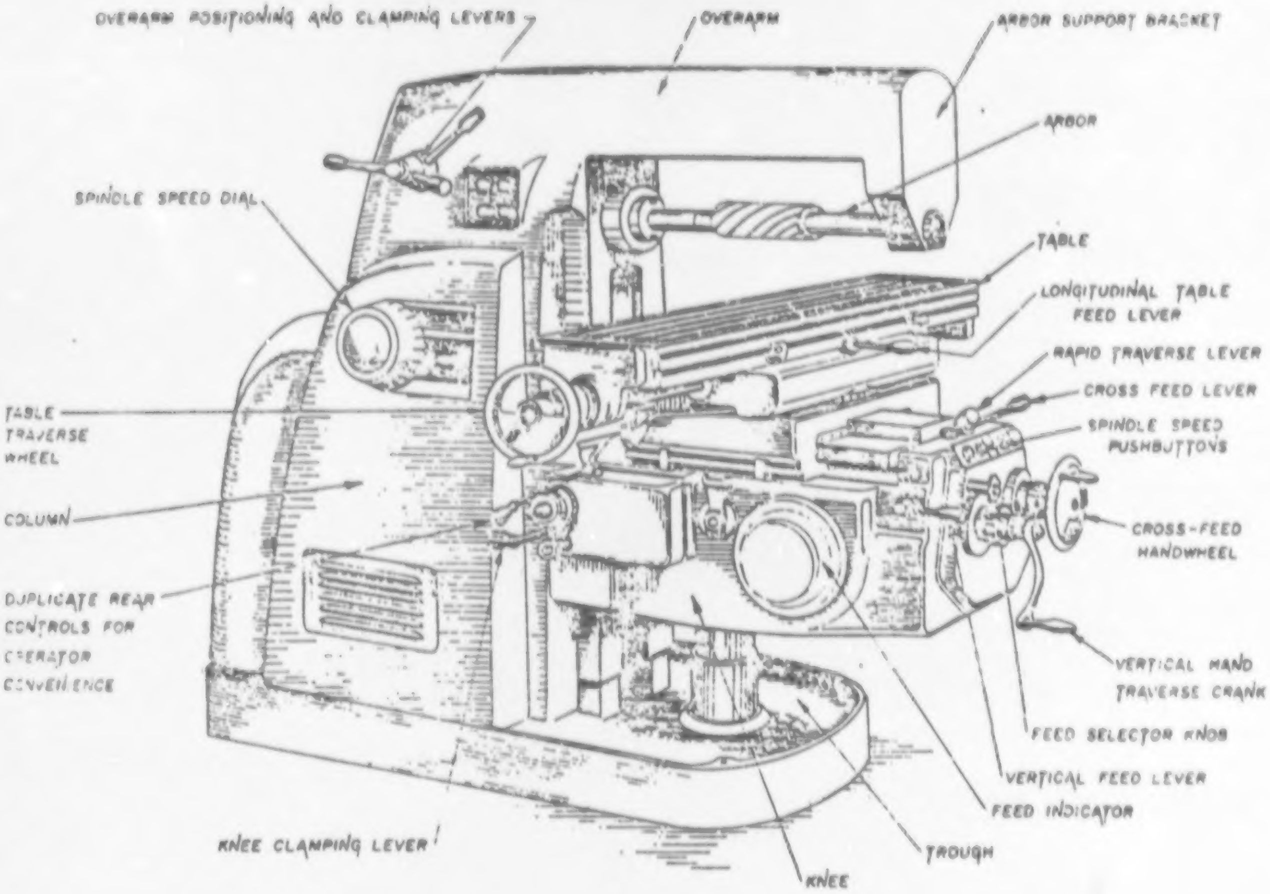
26. Once a cutting pass is made, do not back out or return to the starting position without proper clearance.

27. Do not climb cut without specific permission.

28. Check the depth and the width of the cut, the cutter rotation, plus the speed of the cutter and the power feed before starting the machine.

29. Never clear chips away while the machine is in operation. Keep your hands away from the chips and the point of operation.

TRANSPARENCY MASTER


OVERARM POSITIONING AND CLAMPING LEVERS
OVERARM
ARBOR SUPPORT BRACKET
ARBOR
SPINDLE SPEED DIAL
TABLE
LONGITUDINAL TABLE FEED LEVER
RAPID TRAVERSE LEVER
CROSS FEED LEVER
SPINDLE SPEED PUSHBUTTONS
TABLE TRAVERSE WHEEL
COLUMN
CROSS-FEED HANDWHEEL
DUPLICATE REAR CONTROLS FOR OPERATOR CONVENIENCE
VERTICAL HAND TRAVERSE CRANK
FEED SELECTOR KNOB
VERTICAL FEED LEVER
FEED INDICATOR
KNEE CLAMPING LEVER
TROUGH
KNEE

HORIZONTAL MILLING MACHINE

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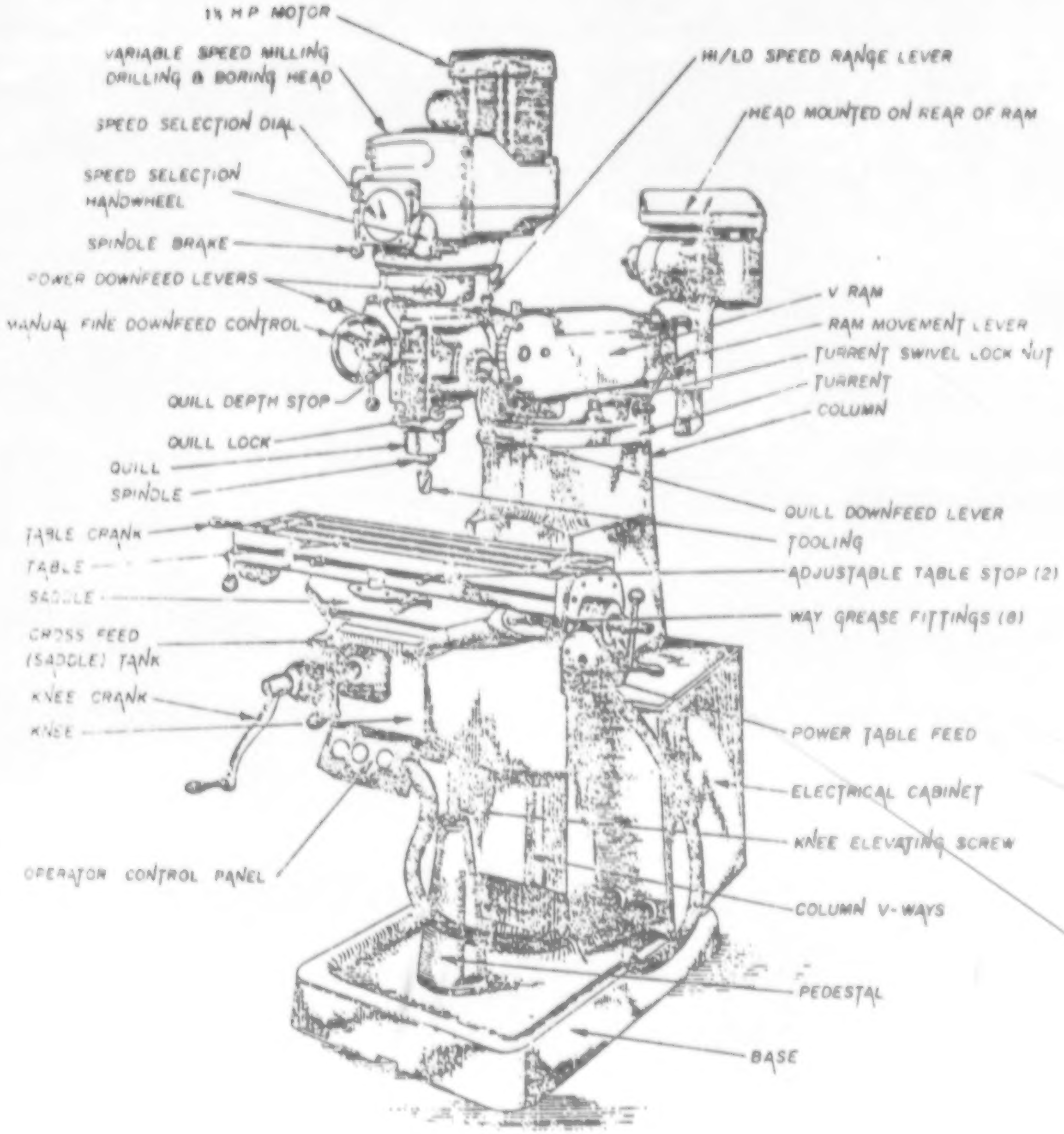
TRANSPARENCY MASTER


1½ H P MOTOR
VARIABLE SPEED MILLING DRILLING & BORING HEAD
SPEED SELECTION DIAL
SPEED SELECTION HANDWHEEL
SPINDLE BRAKE
POWER DOWNFEED LEVERS
MANUAL FINE DOWNFEED CONTROL
QUILL DEPTH STOP
QUILL LOCK
QUILL
SPINDLE
TABLE CRANK
TABLE
SADDLE
CROSS FEED (SADDLE) TANK
KNEE CRANK
KNEE
OPERATOR CONTROL PANEL
HI/LO SPEED RANGE LEVER
HEAD MOUNTED ON REAR OF RAM
V RAM
RAM MOVEMENT LEVER
TURRENT SWIVEL LOCK NUT
TURRENT
COLUMN
QUILL DOWNFEED LEVER
TOOLING
ADJUSTABLE TABLE STOP (2)
WAY GREASE FITTINGS (8)
POWER TABLE FEED
ELECTRICAL CABINET
KNEE ELEVATING SCREW
COLUMN V-WAYS
PEDESTAL
BASE

VERTICAL MILLING MACHINE

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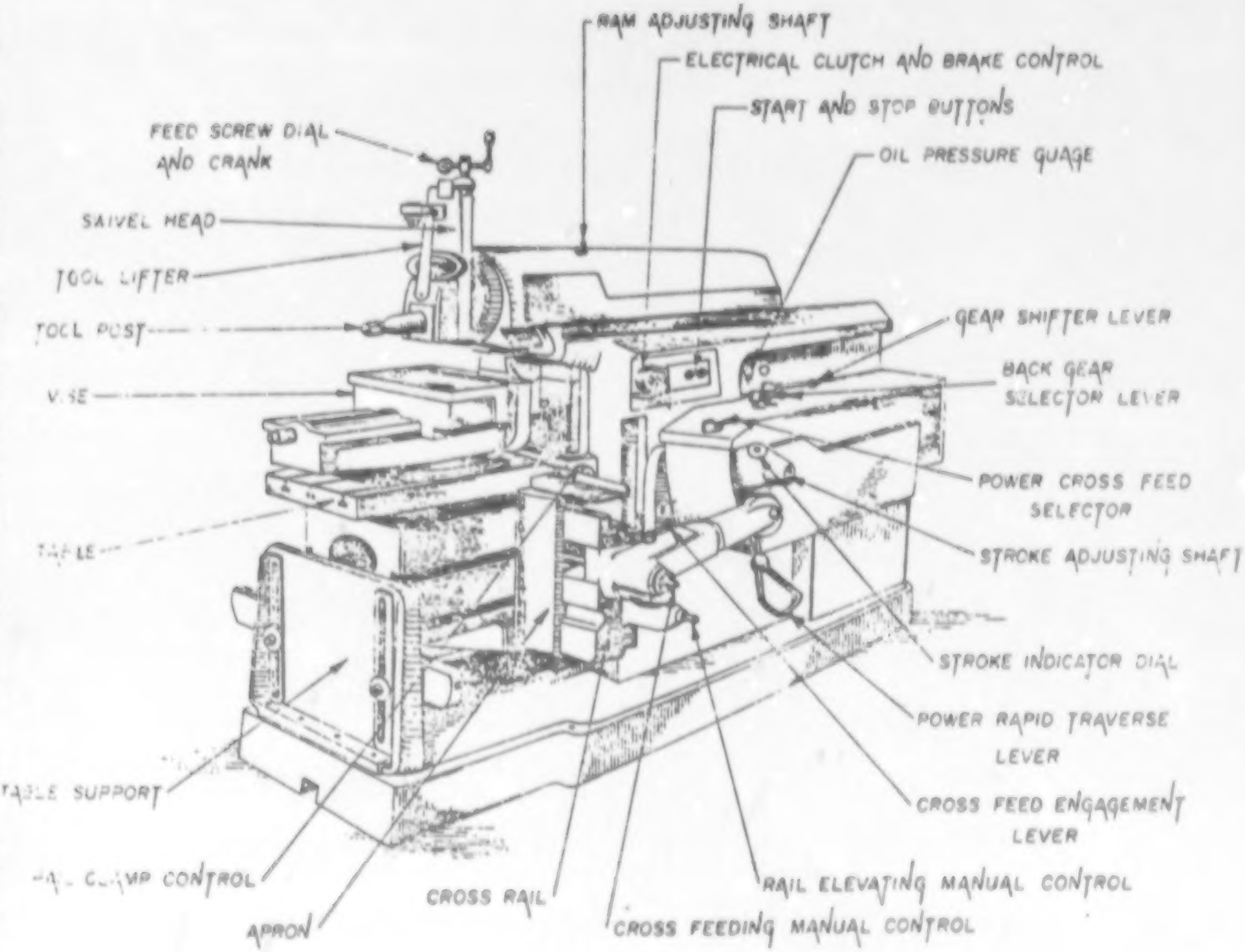
SAFETY INSTRUCTIONS FOR OPERATING A METALWORKING SHAPER

1. Obtain permission from your instructor before using the shaper.
2. Protect your eyes with a face shield, safety glasses, or goggles.
3. Be sure fences and guards are fastened tightly in place.
4. Make adjustments or set up only when the machine is at a dead stop.
5. Use a soft hammer or a mallet to set work on the parallels.
6. Secure work firmly in the machine.
7. Select the proper tool for the job.
8. Set the machine for the proper depth of cut.
9. Be sure that ram and head will clear your work and any holding device.
10. Use the proper file to remove sharp burrs and corners to prevent fingers from being cut.
11. Make sure that no one except you is inside the operator's zone.
12. Check to see that the lever is in a neutral position before starting the motor.
13. Stand to one side of the machine.
14. Turn on the power after permission is given.
15. Keep your hands away from the cutting tool and the line of travel of all moving parts.
16. Turn off the power after using the shaper and stand by until the machine has stopped.
17. Clean the machine and the area with a brush.
18. Make sure all guards are secure before starting the machine.
19. Do not lay either the tools or tooling on any part of the machine.
20. Never remove chips while the machine is in motion.

TRANSPARENCY MASTER


RAM ADJUSTING SHAFT
ELECTRICAL CLUTCH AND BRAKE CONTROL
START AND STOP BUTTONS
OIL PRESSURE GUAGE
FEED SCREW DIAL AND CRANK
SAIVEL HEAD
TOOL LIFTER
TOOL POST
VISE
GEAR SHIFTER LEVER
BACK GEAR SELECTOR LEVER
POWER CROSS FEED SELECTOR
TABLE
STROKE ADJUSTING SHAFT
STROKE INDICATOR DIAL
POWER RAPID TRAVERSE LEVER
TABLE SUPPORT
CROSS FEED ENGAGEMENT LEVER
RAIL CLAMP CONTROL
CROSS RAIL
RAIL ELEVATING MANUAL CONTROL
APRON
CROSS FEEDING MANUAL CONTROL

METALWORKING SHAPER

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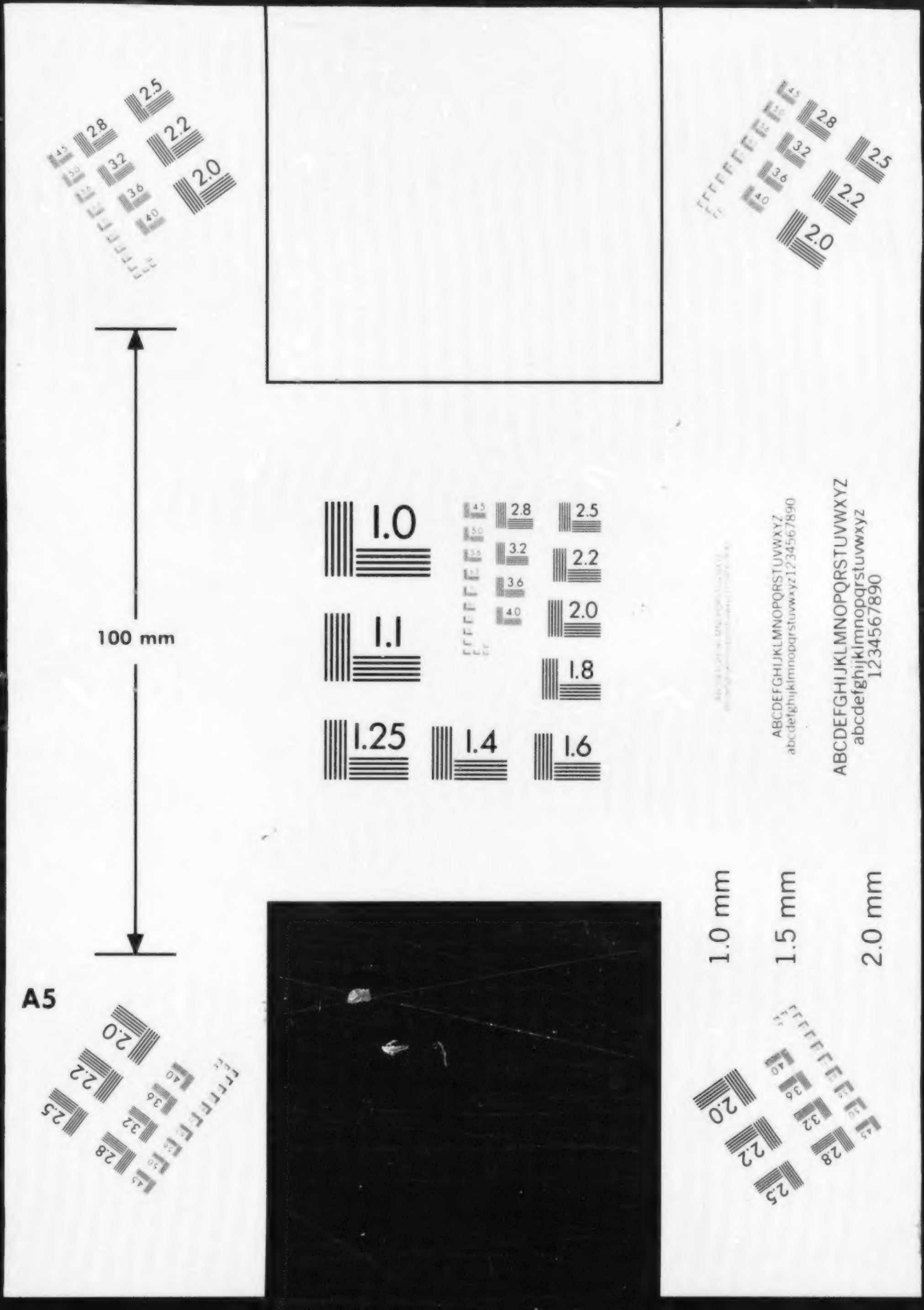

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100 mm
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1.1
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2.5
2.8
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abcdefghijklmnopqrstuvwxyz1234567890
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890
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1.5 mm
2.0 mm

PG

APPENDIX 4

SUGGESTED PROJECT LISTINGS

SHEET METAL PROJECTS

	Book Number	Page Number
THREE DRAWER TOOL BOX	64	224 - 226
CONTEMPORARY CHANDELIER	66	75
BARN SHAPED MAILBOX	66	88 - 89
PORTABLE BARBECUE GRILL	66	52 - 54
EARLY AMERICAN MAIL BOX	66	22
TANK WITH WIRED EDGE	12	178
RECTANGULAR DUCTELBOW	12	179
ROUND TEE	12	190
THREE-PIECE ELBOW	12	192 - 194
ROUND FITTING BY TRIANGULATION	12	205 - 208
PAPER PAD	3	434
PATIO LAMP	68	7
HUNTER'S SEAT AND SHELLBOX	3	440
BUCKET	12	265
FUNNEL	12	266 - 267
WASTE BASKET	12	268 - 271
TOOL BOX	12	273 - 275
BOX WITH SLIDING TOP	12	279
PATIO LAMP	3	437
CHARCOAL SCOOP	65	44
COFFEE SERVER	65	36
PATIO DUST PAN	65	26

CASTING PROJECTS

	Book Number	Page Number
GOBLET	64	161 - 166
DESK PEN BASE	2	580
DOOR KNOCKER	67	81 - 82
CASTMASTERS	67	65 - 68
DOORKNOCKER	65	71
BOOKENDS	65	55
NAMEPLATE	65	52

WELDING PROJECTS

	Book Number	Page Number
BAG CART	68	26 -27
PORTABLE GRILL	68	30 - 31
HOSE CART	68	20 - 21
TABLE LAMP	68	4
BASKETBALL GOAL	69	222 - 223
UTILITY TRAILER	69	234 - 235
NATURAL GAS BARBEQUE	69	106 - 107
GAS, WOOD, AND SMOKER BARBECUE	69	120 - 124
HAND TRUCK	65	38
UTILITY TRAILER	69	264 - 265
CAR RAMPS	69	200 - 201
OXYACETYLENE CUTTING AND WELDING TABLE	69	204 - 205
TWO-WHEEL UTILITY TRAILER	68	12 - 13 sec. II
WELDING TABLE	68	2 - 3 sec. II

MACHINING PROJECTS

	Book Number	Page Number
CAMERA TRIPOD	64	211 - 213
CANDLESTICKS	64	188 - 189
HAMMER HEAD	63	10
PEEN HANDLE	63	12
PARALLEL CLAMP	63	22
TAP WRENCH	63	40 - 42
SURFACE GAUGE	63	60 - 64
DRILL PRESS VISE	65	28 - 29
CHAIN BREAKER	64	220 - 222
ADJUSTABLE SQUARE	4	283
SOLID SQUARE	4	282
SCRIBER	4	283
MEAT TENDERIZER	4	490
PHONE FINGER	65	75
CONTEMPORARY CANDLESTICKS	65	67
PUNCH HAMMER	65	63
MUG	65	59
PICTURE FRAME CLAMP	65	54
GAVEL PAPERWEIGHT	65	41
TWO PIECE VISE	65	18 - 19
BUFFING HEAD	65	12
SERVING TRAY	65	6

APPENDIX 5

RESOURCES: FILM, COMPUTER PERIODICALS, ROBOTICS

RESOURCES FOR FILMS

Modern Talking Picture Service
5000 Park Street North
St. Petersburg, Florida 33709
813/541-5763

RESOURCES OF MANUFACTURING

CNC - Robotics - CAD - Computers

1. Brodhead-Garrett
   1-800-841-4967

2. EMCO-Lux Corporation
   P. O. Box 07824
   2050 Fairwood Avenue
   Columbus, Ohio 43207

3. Technovate, Inc.
   910 S. W. 12 Avenue
   Pompano Beach, Florida
   305/946-4470

4. Cincinnati Milacron
   Industrial Robot Division
   215 S. West Street
   Lebanon, Ohio 45036

5. Bridge Port Machines
   500 Lindley Street
   Bridgeport, Connecticut 06606
   205/367-3651

6. Paxton-Patterson
   5719 West 65th Street
   Chicago, Illinois 60638
   1-800-323-8484

COMPUTER SOFTWARE

1. Abraxas
   P. O. Box 1416
   Eugene, Oregon 97449
   503/485-6747

2. MIND
   Statewide Teaching Aids
   P. O. Box 8241
   Alexandria, Louisiana 71360
   318/445-2572

3. Career Aids, Inc.
   8959 Lurline Avenue, Dept. M
   Chatsworth, California 91311
   818/341-8200

4. Goodheart-Willcox Company
   123 W. Taft Drive
   South Holland, Illinois 60473
   1-800-323-0440

5. Apple-Swap
   607 Sycamore
   Starkville, Mississippi 39759

6. MECC Software
   State Department of Education
   Baton Rouge, Louisiana

7. CENLA Professional Development Center
   Dr. Bob Gillan
   PDC, TEC - Northwestern State University
   Natchitoches, Louisiana 71497
   318/357-4182

COMPUTER PERIODICALS

Classroom Computer News
51 Spring Street
Watertown, MA 02172

Educational Computer
P. O. Box 535
Cupertino, CA 95015

Electronic Learning
902 Sylvan Avenue
Englewood Cliffs, NJ 07632

School Microware Reviews
Dresden Associates
P. O. Box 246
Dresden, ME

The Computing Teacher
Department of Computer & Information Services
University of Oregon
Eugene, OR 97403

Electronic Education
Electronic Communications
Suite 220, Executive Center Drive
Tallahassee, FL 32301

School Microware Directory
Dresden Associates
P. O. Box 246
Dresden, ME 04342

T.H.E. Journal
Information Synergy
P. O. Box 992
Acton, MA 01720

Robotics Age
174 Concord Street
Peterborough, NH 03458
603/924-7136

APPLE-SWAP

INFORMATION SHEET

APPLE-SWAP (Software With A Purpose) is an international software clearinghouse for educational programs developed on and for the Apple microcomputer. The stated objective is to assist teachers, administrators, parents, but most importantly, students in the advancement of facilitative learning experiences with the Apple. It was founded in 1980 by Dr. Dan Brook, Associate Professor and Assistant Department Head of the Vocational Education and Technology Department at Mississippi State University, and Mr. Larry Anderson, former industrial arts teacher, middle school principal, and now instructor in the VED Department with Dr. Brook. We hope that many of the advantages gained as a result of using APPLE-SWAP will be carried over into the entire school environment.

The clearinghouse was originally designed for Industrial Arts teachers, but later was expanded to serve all Vocational Education. However, as the requests kept coming from other areas, we decided to make it cover all facets of education. We are here to serve anyone who wants help -- and at a VERY reasonable cost!!!

We have set forth some rules governing our software exchange library. The first time you use the library, you should send 2 disks and $2. One of your disks should be blank. It will be kept here to help the library expand. The other disk should have your contributed public domain programs on it. If you don't have any programs to send in the first time, we will be expecting you to contribute later. We will take your programs off, place them into the library, then copy the volumes you requested on your disks and return it to you. On the first exchange, we always send our Introductory Disk (Vol. 10) on the front side of your disk, but we will copy the volume of your choice on the back of the disk. We will copy entire disk volumes, not individual programs.

Each time after your first exchange, you will send $1 per disk side you want copied. For example, 1 side and $1, 2 sides and $2, 3 sides and $3, etc. Please remember that we will copy two volumes per disk, so request two volumes from the library list for each diskette you send. The library list is available for a fee of $1 which covers duplication costs. Updates to the original list will be made available periodically. We feel that it is a good idea to share APPLE-SWAP programs with other teachers in your locality.

Some of you have asked, "Can we request the entire library at one time?" The answer is, "Yes."

We trust that this information has been helpful in explaining our position and our work with APPLE-SWAP. If we can be of service, don't hesitate to let us know.

APPLE-SWAP
607 Sycamore
Starkville, MS 39759

Dr. Dan Brook	323-7000	(Home)
	325-2281	(Work)
Mr. Larry Anderson	324-0677	(Home)
	325-2281	(Work)

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* APPLE - SWAP *
607 SYCAMORE
STARKVILLE, MS 39759
JUNE 22 1984

LISTING OF VOLUMES AND CATEGORIES

VOLUME	CATEGORY	VOLUME	CATEGORY
1	TUTORIALS	43	MISCELLANEOUS
2	UTILITIES	44	MATH
3	UTILITIES	45	MISCELLANEOUS
4	MISCELLANEOUS	46	MISCELLANEOUS
5	GRAPHICS	47	GRAPHICS
6	TUTORIALS	48	MISCELLANEOUS
7	MATH	49	TUTORIALS
8	TUTORIALS, MATH, ETC.	50	TUTORIALS
9	FINANCIAL	51	MUSIC
10	INTRODUCTORY DISK	52	TUTORIALS
11	GAMES	53	UTILITIES--EPSON HIRES
12	GAMES	54	UTILITIES
13	GAMES	55	COMMERCIAL DEM DISK
14	GAMES	56	UTILITIES
15	TUTORIALS	57	APPLESOFT TUTORIAL
16	TEACHER USAGE	58	MISCELLANEOUS
17	UTILITIES	59	INDUSTRIAL ARTS
18	FINANCIAL	60	INDUSTRIAL ARTS
19	MISCELLANEOUS	61	MISCELLANEOUS
20	UTILITIES	62	MISCELLANEOUS
21	MATH	63	MISCELLANEOUS
22	TUTORIALS	64	MISCELLANEOUS
23	MATH, ETC.	65	SOFTDISK
24	GRAPHICS	66	SOFTDISK
25	GAMES	67	MATH
26	MISCELLANEOUS	68	MATH
27	AMATEUR RADIO	69	GRAPHICS
28	AMATEUR RADIO	70	GRAPHICS, ETC.
29	MATH	71	MISCELLANEOUS
30	PHYSICS LAB AIDS	72	MATH
31	UTILITIES	73	MATH.
32	GAMES	74	MISCELLANEOUS
33	MAILING LABELS	75	MATH
34	UTILITIES	76	MISCELLANEOUS
35	GAMES	77	MATH
36	MISCELLANEOUS	78	MISCELLANEOUS
37	TUTORIALS	79	MATH
38	UTILITIES	80	MATH
39	UTILITIES--EPSON	81	MISCELLANEOUS
40	MISCELLANEOUS	82	MISCELLANEOUS
41	GAMES	83	MISCELLANEOUS--SIMULATIONS
42	MISCELLANEOUS		

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.€ #057 -- APPLESOFT TUTORIAL (IAC)            11 FILES
PPLE-SWAP *

'04 A/APPLE SWAP 57         *B 034 A/APPLE SWAP LOGO        *A 005 A/IMPORTANT NOTICE       A 003 APPLESOFT TUTORIAL (C)
23 HELPHELP          *B 034 LOGO                 *A 024 MENUMENU             *A 100 PT 1PT 1
04 PT 2PT 1          *A 100 OREFOREF      *A 017 STRTSTRT
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DL #058 -- MISCELLANEOUS            41 FILES
PPLE-SWAP *

04 A/APPLE SWAP 58          *B 034 A/APPLE SWAP LOGO        *B 008 A/APPLE SWAP MENU             *A 003 A/IMPORTANT NOTICE
14 ADVENTURE                *I 026 ALPHABET & SOUND         *A 005 ANSWER SHEET                  *A 005 BELL SCHEDULE
18 CALORIE COUNTER          *T 001 CHEM GR EXAM             *T 001 CHEM GR EXAM CHEM GR EXAM     *A 017 CHEM GRADER
04 FILE START C-G           *A 033 FLASH CARD               *I 011 GAME OF LIFE                  *A 030 GEOGRAPHY
04 L.N.S                    *I 007 LETTER DISCRIMINATION    *A 017 MARKETING FORMULAS            *A 007 READING DRILL
41 SURVIVAL                 *A 004 TEST APPEND              *A 003 TEST APPEND 1                 *A 003 TEST MAKER
04 TEST TAKER               *I 013 TYPING PRACTICE          *A 016 TYPING PRACTICE-INEEDS WORK   *T 003 WORD LIST
05 Z-AVERAGES               *A 003 Z-DATE                   *T 002 Z-G FILE                      *T 001 Z-FILE
05 Z-FILE INIT              *I 009 Z-GRADING INSTR          *I 002 Z-INTRO NEEDED                *I 003 Z-SCHOOL MENU NEEDED
40 Z-SCHOOL1                *I 002 Z-SCHOOLFILE             *A 005 Z-STUDENT NAMES               *A 005 Z-STUDENT NAMES GRADES
04 Z-TEST GRADES
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DL #059 -- INDUSTRIAL ARTS            38 FILES
PPLE-SWAP *

06 A/APPLE SWAP 59               *I 011 A/APPLE SWAP CATALOG          *B 034 A/APPLE SWAP LOGO              *A 005 A/IMPORTANT NOTICE
18 ABRASIVES                     *A 005 ANTENNA SPECS                 *A 025 APPLE GRAPHICS                 *A 023 BASIC ELECTRICITY TEST
03 BOARD FEET                    *A 004 BREAK-EVEN POINT              *A 013 BUILDING HEAT LOSS             *A 012 CAPACITANCE-RESISTANCE
05 CAPACITIVE REACTANCE          *A 003 CIRCLE AREA & CIRCUM          *A 021 CIRCUIT REQUIREMENTS FOR HO    *A 023 COMMON MACHINE SHOP FORMU
08 COMPUTER TEST                 *A 017 CONSTRUCTION FRAMING ESTIMA   *A 007 CYLINDER DISPLACEMENT          *A 007 DISGUISE CHANCE
05 EGGCRAFT CARRIER              *A 036 ENERGY GRAPHS                 *A 004 FIGURING INTEREST              *A 010 FILM DEVELOPER
10 FRACTION PRACTICE             *A 026 FREE E'PRISE INC STATEMENT    *A 024 HORSEPOWER                     *A 003 HOW TO RUN A PROGRAM
13 INDUSTRIAL ARTS INTRODUCTIO   *A 006 LAND SPEED RECORD ASSAULT V   *A 006 LOAN/INTEREST COST ANALYSIS    *A 019 LOGGER ACCOUNT
09 METAL LATHE SPEEDS            *A 009 MN-FRACTIONS-DECIMALS         *A 007 OHM'S LAW PROGRAM              *A 015 OHM'S/WATT'S LAW
08 ROOF FRAMING                  *A 010 SHEET METAL PROJECT COSTS
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DL #060 -- INDUSTRIAL ARTS            33 FILES
PPLE-SWAP *

06 A/APPLE SWAP 60               *I 011 A/APPLE SWAP CATALOG     *B 034 A/APPLE SWAP LOGO          *A 005 A/IMPORTANT NOTICE
17 ABRASIVES                     *A 016 BREAK-EVEN POINT         *A 019 C-SYSTEM                   *A 015 CANOE PITCH
11 CONCRETE                      *A 003 COUNTING                 *A 003 DATE                       *A 033 DRAFTING TEST
15 ENGINE TEST                   *A 023 ESTIMATION PLUS          *A 013 FRACTION PRACTICE          *A 019 GENERAL PLASTICS TEST
03 GRADE SCALE                   *A 023 HELLO                    *A 003 MEASUREMENT DRILL 1        *A 009 MOBLEY'S FOLLY
21 OHM'S LAW FILE                *A 007 OHM'S LAW PROGRAM        *A 002 OHM'S LAW TUTORIAL         *A 011 PROPERTIES OF A CIRCLE
21 R.0                           *A 017 R.S                      *A 015 RESISTOR COLOR DECODING    *B 044 SCIENTIFIC NOTATION
09 SHEET METAL PROJECT COSTS     *A 004 SUN DAY                  *A 006 TIME+MONEY                 *A 031 WOOD CHARACTERISTICS
19 WOOD SAFETY DRILL
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DL #061 -- MISCELLANEOUS            34 FILES
PPLE-SWAP *

C6 A/APPLE SWAP 61               *B 034 A/APPLE SWAP LOGO        *B 008 A/APPLE SWAP MENU         *A 005 A/IMPORTANT NOTICE
13 ANNUITY                       *A 018 BASKETBALL               *A 016 BUMBLE-BEE                *A 017 CATSUP
17 CHESS BOARD                   *A 035 DEPSTRAT                 *A 011 DODGE                     *A 002 DOS 3 3 ON LANG CARD
26 DOS 3 3 ON LANG CARD 1        *A 003 FIREWORKS                *A 004 FREECAT                   *A 004 HELLO/SCROLLING
17 LASER SEARCH                  *A 010 LOADED DIPOLE DESIGN     *T 002 LOG BOOK                  *A 007 LOG BOOK 1 1
09 LOG BOOK 1 1 INSTR            *T 002 LOG BOOK COMMENTS        *B 003 LOG BOOK 2                *A 014 LOG NET CONTROL
17 MODEM CHESS                   *I 007 MODEM DEMO 1             *I 007 MODEM DEMO 3              *A 003 MODEM TEXT FILE TRANSFER
18 PHONE DIRECTORY III           *A 032 ROULETTE                 *B 034 RTTY INTERFACE PIC        *A 008 RTTY PICTURE LOADER
3 TEST FILE READ AND PRINT 1     *A 004 TOKEN
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VOL #011 -- GAMES            16 FILES
* APPLE-SWAP *

*A 004 A/APPLE SWAP 11            *I 011 A/APPLE SWAP CATALOG     *B 030 A/APPLE SWAP LOGO      *A 005 A/IMPORTANT NOTI
*I 008 BRAIN BUSTERS              *I 010 MV BLACKJACK             *I 035 COLOR GAMEPACK II      *I 008 COLOR GAMEPACK
*I 009 CRAPS                      *I 020 EDUCATIONAL GAMES        *I 007 HANDBALL & PONG        *I 006 HIDDEN HOUSE
*I 012 KENO                       *I 008 MASTERMIND               *I 012 MATCHES                *I 010 MIDWAY
*I 013 MINI TREK                  *I 012 OTHELLO KEYBOARD         *I 006 PING PONG              *I 035 POKER
*I 005 ROCKS PAPER & SCISSORS     *I 013 SEAWAR                   *I 015 SIMPLE SIMON           *I 010 SLOT 1
*I 033 STAR TREK                  *I 044 TIC TAC TOE II
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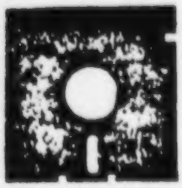

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P        D   D    C
P        DDDD      CCCC
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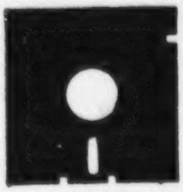

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F     R   R E     E         L     O   O  A A  D   D E     R   R
FFF   RRRR  EEE   EEE       L     O   O AAAAA D   D EEE   RRRR
F     R   R E     E         L     O   O A   A D   D E     R   R
F     R   R EEEEE EEEEE     LLLLL OOOOO A   A DDDD  EEEEE R   R
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The FREELOADER is published by the

CENLA PROFESSIONAL DEVELOPMENT CENTER.

Direct any inquiries to Dr. Bob Gillan,

PDC, TEC-NSU, Natchitoches, La. 71497.

318/357-4182

(FLOPPY) ELECTRONIC MAGAZINES

The publishers of Softdisk Magazette* (Apple Format) and MAG-80 (TRS-80 III or IV Format) have authorized me to share a single issue of their electronic magazine with our schools. Mail 2 disks for the Softdisk or one for the MAG-80 to the PDC for your copies of these outstanding educational buys.

Subscriber info:

Softdisk, 3811 St. Vincent, Dept. 511, Shreveport, La. 71108 (12 issues - $55.00)

MAG-80, Dept. B., P.O Box 8470, Bossier City, La. 71113 (12 issues - $90.00)

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PUBLIC DOMAIN SOFTWARE AVAILABLE

Our Apple Compatible library continues to grow providing us with more software to share with you. Below is a general listing of the 140+ disks available:

Education - 40
Graphics - 6
Utilities - 10
Business & Stat - 16
Home & Hobby - 4
Novelties - 4
Games--Misc. - 13/Fantasy/Adv. - 21
Electronic Magazines/Club Disks - 26

We have ten TRS-80 III & IV disks and really need contribution in this area.

Send your disks (including any public domain programs that you have) to the PDC and specify your interest based on the above categories.

**Commodore support is planned for spring/summer.

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COMPUTER FILM

"Tender Loving Computers" is a free film for educators to use to inform teachers and parents how children are preparing to live in a computerized world.Write: Mattel Toys. 5150 Rosecrans Ave.,Hawthorne, CA. 90250.

CURRICULUM PROJECTS

National Diffusion Network is a publication that lists 16 validated projects from around the country. Copies of the publication may be obtained by calling or writing:

Mr. Martin McConnell, Project Director
NDN State Facilitator
College of Education/BERS
2046 Terrace Ave.
University of Tennessee
Knoxville, Tn. 37996
615/974-4165

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RESOURCE GUIDE

A resource guide containing suggestions on hardware purchase planning, software selections, and a list of administrative software packages is available from the Florida Department of Education. To obtain this guide, write or call:

Chase W. Crawford
Management Systems & Services
Florida State Department of Education
Tallahassee, FL. 32301
904/487-2280

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TEACHING TIPS

J.L. Hammett Microcomputer Division has a Curriculum Idea Sheet on using particular software packages in the classroom. Copies may be requested from:

Curriculum Idea Sheet
Microcomputer Division
J.L. Hammett Co.
Box 545
Braintree,MA. 02184

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COMPUTER CLUB KITS

Apple Computer Kits for elementary and secondary levels are available through request of the principal on school letterhead, name of sponsor is required. Write to: Apple Computer Club, Box 948, Lowell, MA. 01853

PERIODICALS FOR METALS INSTRUCTORS

Send for your subscription to the following:

Machinery, 200 Madison Ave.; New York, NY 10016

Industrial Arts & Voc. Ed., 866 3rd Ave., New York, NY 10022

Industrial Teacher, 1201 16th North West, Washington, D.C. 20036

Industrial Design, P. O. Box 2153, Radnor, PA 19089

Machine Tool Blue Book, Hitchcock Pub. Co., Wheaton, IL 60187

Industrial Finishing, Hitchcock Pub. Co., Wheaton, IL 60187

School Shop, Box 8623, Ann Arbor, MI 48107

Stabilizer, Lincoln Electric Co., 22787 St. Clair Ave., Cleveland OH 44117

The Home Shop Machinist, Vollage Press, Inc., P. O. Box 968, Traverse City, MI 49684

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